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ABSTRACT

Seven papers and one abstract of a paper are presented from the 1995 CAUSE conference track on new technology issues faced by managers of information technology at colleges and universities. The papers include: (1) "The Use of Groupware in the Reengineering of Business Processes" (Richard M. Kesner), which discusses the role of new information technology on the administration of Babson College; (2) "Business Process Reengineering: A Consortium Approach with End Users as the Architect Produces Dramatic Results" (Florida Community College Software Consortium); (3) "Wireless Networking at Ohio State University" (Robert S. Dixon); (4) "Merging of Voice, Video, and Data Over a Single Cabling Infrastructure" (James B. Dronsfield), which focuses on technological integration at Duke University; (5) "A Cooperative Approach to Document Imaging, Storage, and Retrieval" (Harold T. George), which describes a St. Mary's University document imaging project; (6) "Object Think: A Step Toward Object Oriented Implementation" (Patrick Bauer and Harry Reisenleiter), an abstract of a paper on team goals and object orientation; (7) "Application Delivery in the 90s: A Framework for Change" (Brenda Bangert), on Stanford University's experiences with the replacement of its administrative information systems; and (8) "Multimedia and Asynchronus Learning: Changing the Role of Academic Computing" (Arthur S. Gloster II and Steven A. Saltzberg), reports on Virginia Commonwealth University's efforts to integrate digital technologies across the curriculum. Some papers contain references. (MDM)

ED 392 339

TRACK 5
NEW TECHNOLOGIES

Coordinator: Douglas E. Hurley

Realizing the Potential of Information Resources:
Information, Technology, and Services

Proceedings of the 1995 CAUSE Annual Conference

HE028927

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Cause 95

Proceedings for Annual Conference:

The Use of Groupware in the Reengineering of Business Processes

(to be delivered November 29, 1995)

BABSON

COLLEGE

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The Use of Groupware in the Reengineering of Business Processes

Richard M. Kesner, Chief Information Officer

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Abstract:

The principles and business practices of reengineering and other change management strategies have been around for decades. More recently, practitioners have stressed the central role of information resource management and information technology enablement in achieving institutional reengineering objectives. This session takes an "in the trenches" view of these efforts, considering project management, change team composition, process modeling, and the performance metrics for both customer service enhancement and operating cost reduction. The session then considers in some detail the use of various collaborative I/T tools, including: electronic mail, electronic conferencing, and workflow-enablement software, as an integral part of these activities.

Richard M. Kesner, Chief Information Officer at Babson College and President of RMK Associates, Inc., will begin by briefly detailing a reengineering process model and its I/T underpinnings. To this end, he will address the institution's need for a formal information architecture and I/T infrastructure. With these capabilities in place, the institution will be positioned to move forward with a major change initiative.

Mr. Kesner will then apply this model as a lens to view Babson College's transformation efforts. This case study will include a discussion of the role of Lotus ***Notes*** as a collaborative tool; Banyan ***Beyond Mail***, Action Technology ***Action WorkFlow***, and Microsoft ***Visual Basic*** and ***SQL Server*** as tools for building informated and automated business processes; and ABT ***PowerCampus***, US Lan ***Fundmaster Financial Software***, and Sequitur ***Admission System*** as workflow-enabled applications. The following pages summarize the session's findings.

The Crisis in Higher Education - the Need for Change:

Many higher education leaders in the United States now believe that our colleges and universities face a major crisis. The components of this crisis are clear to us all:

- slow job growth and stagnant income levels.
- tuition growth at levels greater than the rate of inflation.[1]
- a rapidly growing gap between all sources of student funding and the capacity of students and their families to pay.[2]
- a radical change in student demographics, requiring higher costs to recruit, educate, and support.
- a Federal financial aid structure under siege by the government for what it costs and criticized by the public because it does not meet current need.[3]
- the more general loss of public trust in higher education.
- a questioning of the value and need of traditional higher education, encouraging the growth of work place alternatives.

Given these circumstances, it is clear that collegiate institutions cannot continue to operate as they have in the past. They must change or cease to exist. According to

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[1]Operating costs and the tuition and fees continue to rise. The mean and median undergraduate tuition and fees at independent institutions in Massachusetts rose over 11% each from 1991 to 1993 alone. Coupled with that, current fund expenditures for Massachusetts, New England, and the United States rose 93%, 93%, and 89.9% respectively from 1983 to 1990 while revenues decreased 90.1%, 89.4% and 86.4% respectively. The ***Chronicle of Higher Education***, the ***New York Times***, and many professional journals regularly report on the growing gap between the cost of a college education and the ability of the typical U.S. family to meet these financial requirements.

[2]For example, the amount of **unmet need** for undergraduate students at Babson College has risen from $73,000 in 1991/2 to a projected $851,000 in 1993/4 (an increase of over 1000%). If Babson were to fund this gap, it would have an immediate impact on revenues because 93% of all financial aid dollars are currently funded from general revenue (i.e. student tuition dollars).

[3]Nationally, a $2 billion deficit in the Pell Grant Program has reduced the chances for federal aid and hence a critical component in college funding for many students. Furthermore, between 1986 and 1992, the estimated total state grant aid awarded by Massachusetts dropped from $66,974,000 in 1986 to $39,989,000 in 1992. Here at Babson the financial aid budget underwritten by tuition and endowment dollars has grown by approximately 375% between 1986 and 1992. The College's ability to fund its financial aid program in light of other major strategic initiatives has diminished while the student need for financial aid has radically increased (from 32% of all undergraduates in 1989/90 to 49% today).

Myles Brand, President of the University of Oregon, colleges and universities have two options:

> ***First, members of the academy can debate possible reforms and then cautiously pursue them, which is a tack many of us prefer. Or second, we can challenge one another to think expansively and to debate bold new directions in higher education - directions that break from conventional paradigms in ways that range from creative to radical.***[4]

Babson College faces the same obstacles as the rest of higher education. Moreover, the College has adopted a long-range strategic plan that will rapidly propel them into the forefront of business education. This approach has and will continue to require significant resources - both human and financial, far exceeding the institution's current means.[5] For example, the remaking of the Two-year MBA program has positioned Babson College at the leading edge. The delivery of this program costs considerably more than its predecessor. Similarly, the College will need to invest more heavily in its undergraduate program as it is redesigned.[6] Though both of these efforts are critical to the immediate and future viability of Babson as an institution, neither will, in and of themselves, generate significantly increased revenues to cover the added costs of development, implementation, and ongoing support. At another level, the College requires full-time faculty, facilities, information technologies, and library resources far beyond those that complemented past modes of program delivery. These enabling services further raise the cost of overall operations.

In quantitative terms, the College currently requires nearly an additional $1.4 million dollars annually to develop and run its new educational programs. Capital, information technology, and library requirements are presently underfunded by approximately fifty percent (50%), another $1.2 million dollars annually. These figures cannot be offset by a growth in tuition and fees. In fact, to be competitive today, Babson is committed to annual increases in revenues pegged to the consumer price index. Furthermore, the College plans to reduce undergraduate enrollment to approximately 1600 by 1997/98, in line with the capacity of the

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[4]Myles Brand, "The Challenge to Change: Reforming Higher Education," Educational Record (Fall, 1993): 7-13.

[5]Most institutions of higher education rely upon endowment income as well as tuition dollars to cover their operating costs. Lacking a substantial endowment fund, Babson College must rely largely on its annual revenues to pay for both current operations and future program development.

[6]Graduate Dean Tom Moore has documented nearly a doubling in faculty contact hours in the new MBA program, pushing the costs of this program beyond his limited strategic development fund. Steve Schiffman, the Undergraduate Dean, has begun the planning for a new curriculum. It is clear from the already-established undergraduate cluster program that anticipated undergraduate teaching changes will also require substantial added resources.

institution's present and planned facilities. In short, while essential costs are going up dramatically, Babson lacks the ability to generate significant added revenues.

Finally, since the College is dependent upon tuition dollars and will continue to be so, Babson must maintain its ability to attract and retain high quality students. While the redesign of both the graduate and undergraduate programs will address the academic requirements of our customers, recent data indicate that the delivery of student-related business services do not meet their needs.[7] Since these activities are central to student perceptions of the value of the Babson experience, the College must address these issues as part of its marketing and business strategies.

Developing an Action Plan:

In the spring of 1993, Babson College's President, William F. Glavin, appointed a Task Force of senior administrators, faculty, and reengineering experts to consider the role that a reengineering process might play in the development and success of the institution. On December 23, 1993, this working group reported back to the President, recommending the initiation of a reengineering effort that focused upon the enrollment process (i.e. the delivery of student administrative services, from initial inquiry through graduation and including such processes as admission processing, registration, student billing, and financial aid packaging). In making this recommendation, the Task Force emphasized the goal of significantly improving the quality of service delivered to undergraduate and graduate students. The report indicated that this goal was to be achieved through the radical redesign of said services while reducing their overall cost to the College.

On February 4, 1994 and at the recommendation of the Reengineering Task Force, President Glavin appointed a Reengineering Design Team (***RDT***). This group included: Richard M. Kesner, Chief Information Officer, as chair; Madge Lewis, Graduate Registrar, as co-chair (and as the designated Director of the reengineering implementation process); Connie Bosse, Associate Dean Undergraduate Studies; Keith Conant, Associate Director of Financial Aid; Carol Leahy, Systems Analyst; Mary Rose, Assistant Dean of Admission; Peg Abbate, Administrative Assistant to the CIO; and Gerry Shaw, consultant (and the former

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[7]Data sources examined by the Task Force in this regard, included: Inquiry Study (July, 1988, conducted by Maguire Associates, Inc.); Quality of Life Study of Current Students (October, 1989, by Maguire Associates, Inc.); Assessment of Student Life and Student Satisfaction (April, 1993, by Maguire Associates, Inc.); Survey of Undergraduate Recruiters and Managers (June, 1993, conducted by The Office of Quality, Babson College); Evening MBA Service Delivery Questionnaire (April, 1993, prepared by Michael D. Cohn); A Study of Diversity (1991, Abt Associates, Inc.); Alumni Study (1991, Pathfinders Research Group); and, interviews with President's Cabinet (November, 1993, conducted by P. Gerard Shaw).

Vice President of Student Affairs at another Massachusetts college). Kesner, Lewis and Shaw were assigned to the RDT on a full-time basis, while the remainder of the team devoted approximately 40% of their time to RDT business.

As set forth in the Reengineering Task Force's **Case for Action** and subsequently endorsed by the College's President and Cabinet, it was the assignment of the Reengineering Design Team to develop a detailed plan for the renewed delivery of student administrative services, i.e. all of those services that complement classroom academic experiences, including: admission, financial aid, registration, student billing, student loans administration, academic planning, field-based learning administration, career services, and so forth. This document was to present descriptive scenarios for a desired state, a plan for their attainment, and operating computer system prototypes.

The RDT reported back to the President and Cabinet (the College's executive management team) on June 30, 1994. At a Cabinet retreat, scheduled from July 12 to 14, 1994, the RDT presented its findings and demonstrated prototypes for a new student registration and academic planning system, a student information system, a student financial services and billing system, a student opinion survey system, and an electronic course catalog.

The Role of Information Resource Management (IRM):

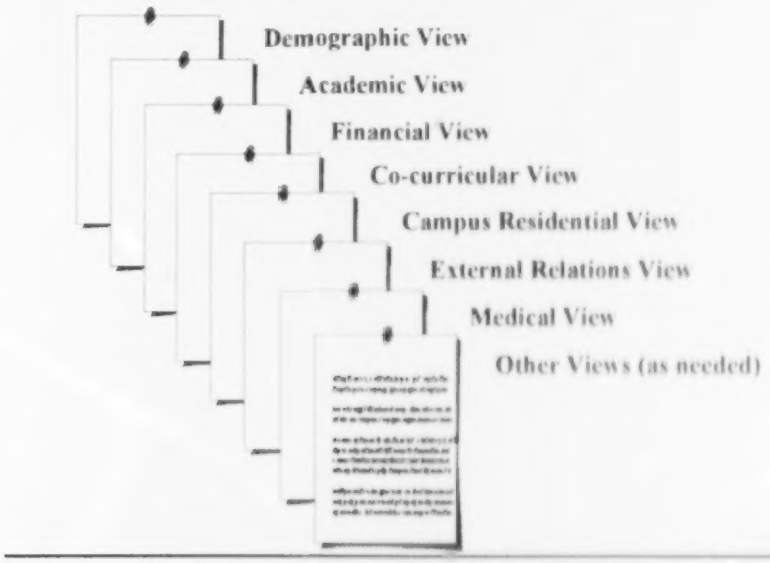
Throughout the reengineering design process, the RDT operated with an understanding that to succeed in this endeavor, the College required a completely new set of information tools. The actual data was already at hand but in a wide variety of inconsistent and largely inaccessible formats. To succeed in reengineering, the College needed an I/T infrastructure that afforded access to authorized users at any time and from both on- and off-campus locations. The computer hardware and software components of this solution were to facilitate broader information access.

At the start of the change process, a considerable amount of time around campus was invested in searching for information, rekeying data already stored elsewhere, verifying the quality and accuracy of information, checking the status of documents flowing within processes, and so forth. In the view of the Reengineering Design Team Chair, a radically different approach was required:

> ***To address this situation, Babson must develop a single, integrated information database that: (1) captures all relevant customer data once, (2) allows for and indeed prompts the information owner to update and/or validate his/her records, (3) provides easy access to authorized users, (4) affords the capability to ask questions, develop scenarios, and conduct trend analysis from the data easily***

and quickly, (5) affords multiple views of the data in its most current and accurate form, and (6) provides access any time and from both on- and off-campus locations.

The Multiple Views of the Student - to be Accessed on a "Need-to-Know" Basis by Authorized Information System Users



As depicted above, the ***demographic data view*** would be created by the student initially with system-driven reminders to keep this record current. Once created, any authorized person on- or off-campus could access this demographic information or a portion of it to service the customer. Similarly, the ***academic data view*** would come about as a function of information fed from automated systems (e.g. academic records and degree audit) as well as from actual data entry (e.g. faculty grades and advisor comments). Given the information-intensive nature of the higher education experience, each student would have many different views in that student's virtual (i.e. electronic) folder.

Investing in Information Technology Enablement:

To achieve the aforementioned information management objectives, Babson College required significant changes to its I/T systems and infrastructure. Starting in 1992, the College moved towards the implementation of a state-of-the-art electronic information network, based upon client/server technologies with these needs in mind. The new network (a.k.a. ***GlobeNet***) employs an optical fiber backbone, connecting all buildings on campus and running the Banyan ***Vines*** operating system. A variety of servers run both old (so-called ***legacy***) applications

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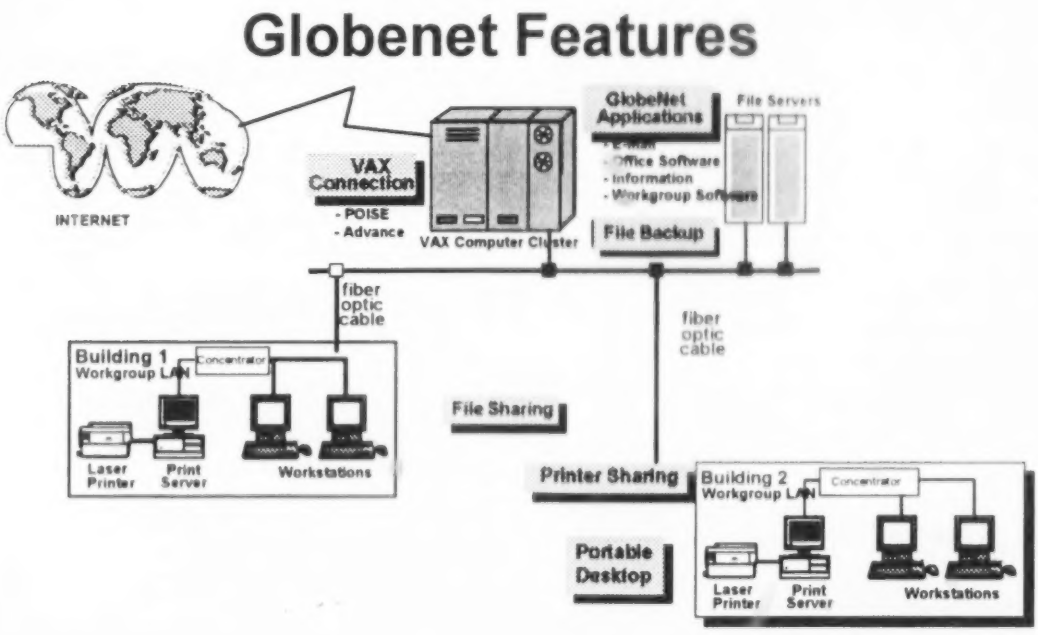
and new client-server-based applications via ***GlobeNet***. On the client side of this equation, the College has replaced old desk-top units with standard 486 personal computers, running ***Windows*** and the Microsoft suite of office automation tools.

The overall network architecture conforms to open industry standards and will allow the College to move quickly, flexibly, and economically towards its new information systems and services objectives. This environment includes file and printer sharing, an electronic mail system that works in conjunction with its standard office automation tools, and cooperative ***groupware***, such as Lotus's ***NOTES*** and Action Technology's ***Action WorkFlow***. Furthermore, the College has invested in the development of an information architecture as forward thinking as its network design.



The information architecture plan is built around a data warehouse driven by a Microsoft ***SQL Server*** relational-database engine. At the present time, the College's ***legacy*** systems feed the data warehouse, but over time, new systems - some purchased for their outstanding client/server performance and others developed in-house - will replace the existing transaction systems. End user access to College data will come less frequently from these systems and more often from the data warehouse via a Babson College-built front end and the employment of off-the-shelf query tools, such as Microsoft ***Query***.

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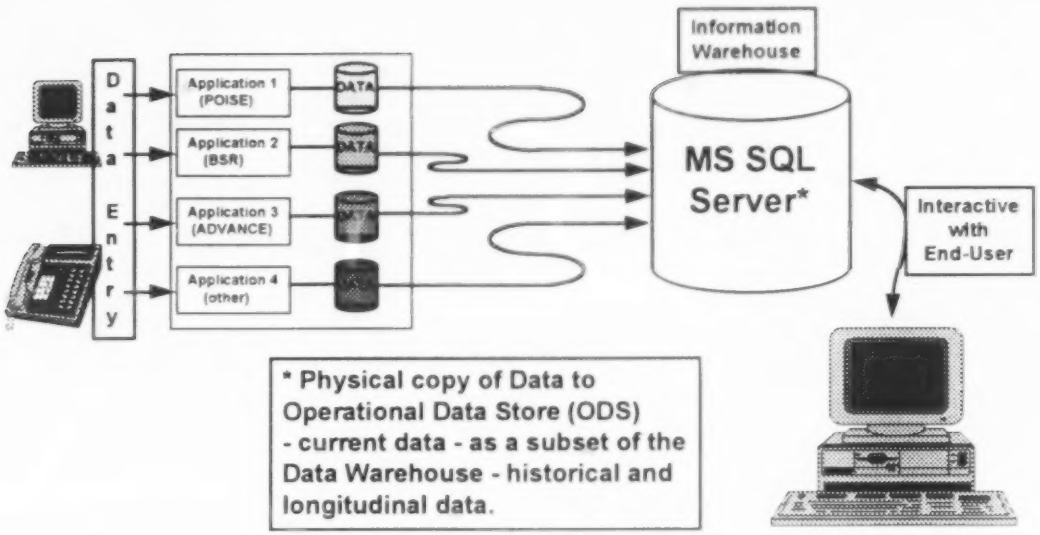
Information Warehouse
MS SQL Server*
Interactive with End-User
Data Entry
Application 1 (POISE)
Application 2 (BSR)
Application 3 (ADVANCE)
Application 4 (other)
DATA
* Physical copy of Data to Operational Data Store (ODS) - current data - as a subset of the Data Warehouse - historical and longitudinal data.

Like the College's office automation tools, these front ends will employ an easy-to-use, point-and-click, graphical user interface (GUI). Thus, all of the information systems will have the same look and feel, facilitating cross-functionality and training. Through this strategy, Babson may replace transaction systems without affecting the end user's information views and business processes. More importantly, as the College reengineers, it will not be restricted by the limitations of functionally-focused information systems. The data warehouse provides the flexibility needed to fashion new information views quickly and economically as business processes change.

Babson's Groupware Strategy:

The success of Babson's reengineering efforts depends upon the timely delivery of effective and efficient I/T tools. Some of these products, particularly Lotus ***Notes*** and Banyan ***Beyond Mail***, play a critical role in the actual change management process by facilitating information sharing and collaboration. Others, like ABT's ***PowerCampus***, US Lan's ***Fundmaster***, and Sequitur's ***Admission System*** provide the College with state-of-the-art, workflow-enabled, client-server software. Still other products, including Microsoft's ***SQL Server***, ***Access***, and ***Visual Basic***, afford both campus I/T specialists and end users the means to present, capture, share, and analyze information in line with the operation of reengineered business processes.

Thus, as part of its change management strategy, Babson has positioned itself to leverage these technologies as part of a larger information architecture plan. Simply stated, this design separates the access and operation of transaction-based applications from customer views of data. It also offers a powerful and efficient

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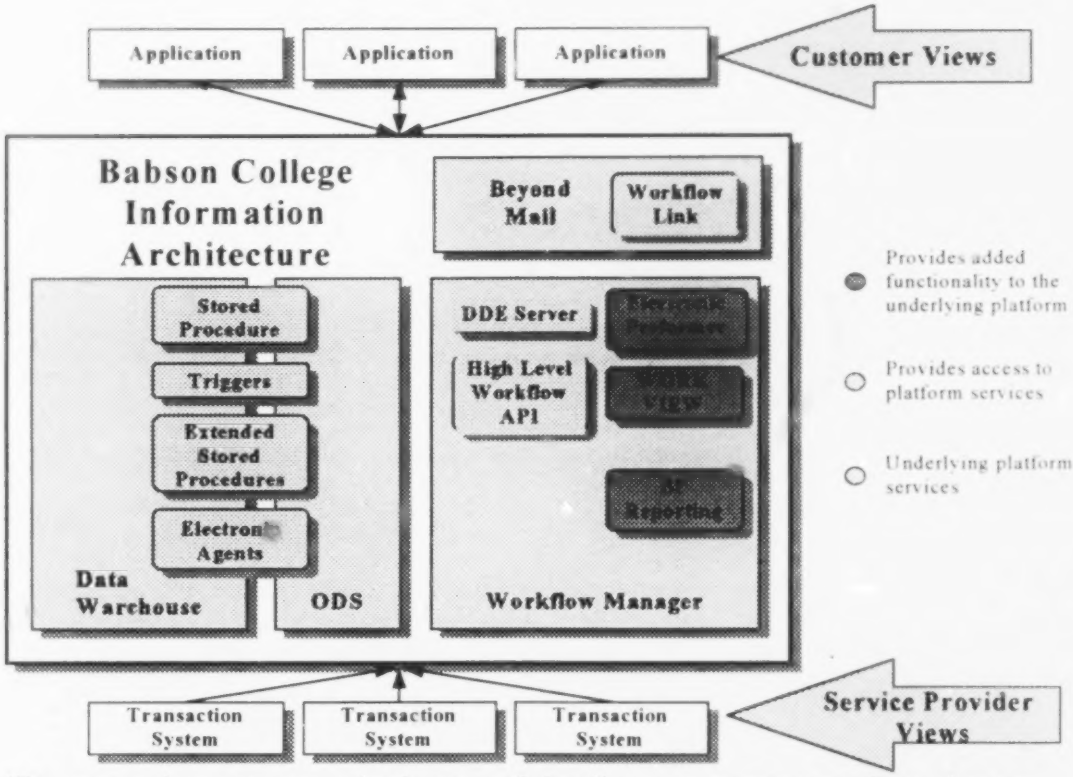
family of workflow-enabled products (a.k.a. *middleware*) to informate and automate processes. The following graphic summarizes this architectural design:



The transaction systems at the bottom of the diagram represent products that are used, owned, and controlled by specific service providers, such as Accounting, Admission, and the Registrar. The data from these systems reaches the end user (students, faculty, and staff) via a complex *middleware* layer. The operational data store (ODS) serves as the repository for current data from transaction systems and the data warehouse serves as its cognate historical repository.

Groupware plays an integral role in the delivery systems built into this design. For example, stored procedures within the ODS and data warehouse may be triggered by specific events (e.g. the closing of an accounting period) or a specific date (e.g. the end of registration add/drop). These triggers automatically release formatted data to the end user (e.g. financial reports, class rosters). At a more sophisticated level, an electronic agent or "performer" will look for certain conditions to exist and will then take action as governed by its program. For example, an agent will periodically remind faculty to submit their grades and students to pay their outstanding account balances. Once the faculty member or student has fulfill his/her obligations, the messaging will stop.

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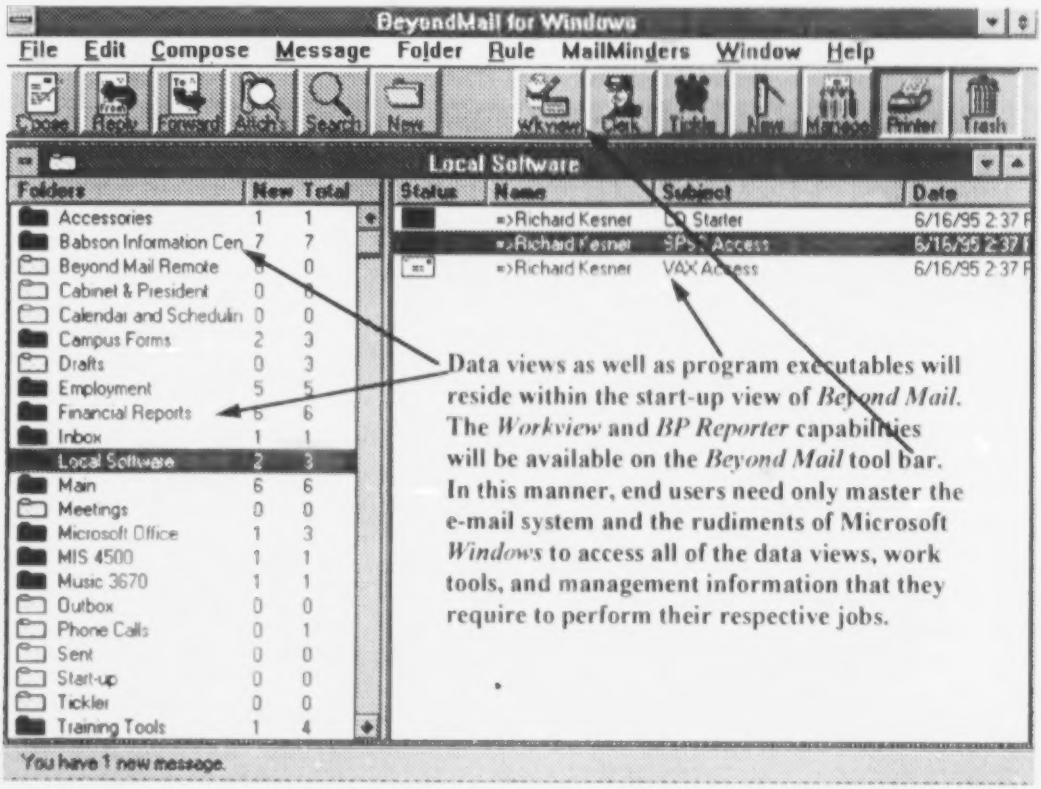
The architecture's workflow-enabled design is most manifest in two other system components: ***Workview*** and ***BP Reporter***. Workview is a user front-end to ***Action WorkFlow*** that lists all the work in an individual performer's work queue. The ***Workview*** product identifies the type of response required (a.k.a. the allowable act(s)) and the priority status of the task. This tool will allow service providers to better manage their daily assignments as it expedites action within business processes. The ***BP Reporter*** monitors processes, service providers, and process conditions of customer satisfaction. For any given process, it identifies all activity in terms of specific performance metrics. This tool provides a graphical representation of processes team performance along with a drill-down capability to ferret out the root causes of performance problems.

The last major component of the Babson information architecture design is electronic mail. We chose our e-mail product (Banyan ***Beyond Mail***) because it possesses both an electronic forms utility and a workflow enablement capability. Babson is integrating the delivery of most information services through this tool.


BeyondMail for Windows
File Edit Compose Message Folder Rule MailMinders Window Help
Local Software
Folders New Total
Accessories 1 1
Babson Information Cen 7 7
Beyond Mail Remote 0 0
Cabinet & President 0 0
Calendar and Schedulin 0 0
Campus Forms 2 3
Drafts 0 3
Employment 5 5
Financial Reports 6 6
Inbox 1 1
Local Software 2 3
Main 6 6
Meetings 0 0
Microsoft Office 1 3
MIS 4500 1 1
Music 3670 1 1
Outbox 0 0
Phone Calls 0 1
Sent 0 0
Start-up 0 0
Tickler 0 0
Training Tools 1 4
Status Name Subject Date
=>Richard Kesner Starter 6/16/95 2:37 P
=>Richard Kesner SPSS Access 6/16/95 2:37 P
=>Richard Kesner VAX Access 6/16/95 2:37 P
Data views as well as program executables will reside within the start-up view of Beyond Mail. The Workview and BP Reporter capabilities will be available on the Beyond Mail tool bar. In this manner, end users need only master the e-mail system and the rudiments of Microsoft Windows to access all of the data views, work tools, and management information that they require to perform their respective jobs.
You have 1 new message.

With Lotus ***Notes*** databases, the Babson ***Worldwide Web*** utility, and a number of workflow-enabled transaction system, this I/T environment is now ready for the new business processes emerging from the College's reengineering efforts.

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BUSINESS PROCESS REENGINEERING: A CONSORTIUM APPROACH WITH END USERS AS THE ARCHITECT PRODUCES DRAMATIC RESULTS

by Florida Community College Software Consortium
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ABSTRACT

Business process reengineering teamed with technology produces dramatic results. Legacy software is transformed into systems, architecturally designed by users. Learn how eight Florida community colleges, which are very diverse, combine fiscal and human resources, through a consortium and vendor partnership, to develop mission critical applications.

The Consortium in partnership with Software AG is using a Rapid Application Development (RAD) methodology to concurrently develop integrated Finance, Student Information, Personnel/Payroll, and Facilities systems. Specialized design teams combine the end user architect with Consortium and Software AG system design experts. These baseline applications will be stored in a central repository and maintained by consortium teams.

BUSINESS PROCESS REENGINEERING: A CONSORTIUM APPROACH WITH END USERS AS THE ARCHITECT PRODUCES DRAMATIC RESULTS

FLORIDA COMMUNITY COLLEGE SOFTWARE CONSORTIUM

I. INTRODUCTION

A. EXISTING SITUATION

The 1990s present a variety of critical challenges to all institutions of higher education. Legislated mandates from both the State and Federal governments arrive with increasing frequency. At the same time, funding from both sources to implement these mandates is shrinking. The demographics of the student population is changing dramatically as a decrease in the number of traditional students is offset by an increase in non-traditional learners.

As a result, most community colleges have been forced to find even more cost-effective ways of doing business. In this rapidly changing and increasingly complex environment, we have come to rely on automated systems to support management decision making and to provide improved student services.

Not only are new systems required, but a new way of developing and maintaining systems is required if the Consortium is to meet the pressing challenges of today's higher education environment. Several factors make this so:

- Current software systems are in place, stable, and functional, but are nearing the end of their life cycles. They are written in languages using design features that are out-of-date and make maintenance complex.
- Most of these applications either do not fully meet current requirements, or do not exist at all.
- Although many requirements are common to all the members of the consortium, each member currently develops and maintains its own systems.
- The time and cost to develop new systems is excessive.

B. CONSORTIUM HISTORY

The 1994 State Legislature appropriated $4.25 million to enable the community colleges and the Division of Community Colleges in the Florida Department of Education to begin compliance with 1987 proviso language requiring the planning and designing of student, personnel, and financial data bases. The appropriation emphasizes and rewards sharing of development activities.

As a response to the Legislature, eight of the twenty-eight Florida community colleges formed the Florida Community College Software Consortium (hereafter known as FCCSC or Consortium) to work collaboratively to develop the four mission critical applications of Financial Management, Student Information, Personnel/Payroll, and Facilities.

The organizational base for the FCCSC is that each of the member colleges has in its software inventory common software products. The FCCSC's common inventory of Software AG (hereafter known as SAG) products allows the member colleges to work in a collaborative atmosphere to meet State mandates.

The decision the FCCSC had to make was whether to purchase a packaged system or develop new systems. Each member college agreed that it wanted systems which would meet State, Federal, and College requirements, but also systems written with tools that could be easily managed, changed and enhanced by the colleges in the future. Existing packages did not meet all of the above requirements. As each college owned SAG products, it was decided the systems should use these tools to develop the new systems.

The participating community colleges are Broward CC, with 26,151 students; Edison CC, with 9,736 students; Florida CC at Jacksonville, with 21,840 students; Indian River CC, with 12,511 students; Miami-Dade CC, with 47,060 students; Okaloosa-Walton CC, with 6,547 students; Palm Beach CC, with 19,022 students; and Tallahassee CC, with 9,902 students (October 1994 Headcount). Together, the full-time equivalent (FTE) of these eight community colleges represents 47.8% of the FTE of the Florida community college students. The logistics of the project are difficult as the distance between the colleges varies, i.e., Okaloosa-Walton CC to Miami-Dade CC is about 609 miles while Miami-Dade to Broward CC is about 22 miles. The fact that colleges, so very different in size and located geographically far apart, voluntarily choose to work together on such a large project is in and of itself significant.

C. WHY FORM THE CONSORTIUM? . . . THE BENEFITS

This diverse group of colleges formed the consortium for the following reasons:

- Meet state data base requirements. When state level data is in integrated data bases, it is absolutely necessary for the colleges to have easily accessible and modifiable integrated data for planning.
- Provide long term solutions. Each college could apply a "band-aid" to meet current state mandates, but this would not help meet additional requirements in the future.
- Develop integrated mission critical applications. Colleges must have integrated data for planning and reporting.
- Gain rewards for sharing development:
  - -- Attain project management expertise. It is needed because the Software AG tools and RAD methodology were new for all the member colleges.
  - -- Build consensus from consortium business expertise. The knowledge gained from a team is greater than from an individual college.
  - -- Increase technical staff expertise. As Software AG tools are new, the technical staff of the colleges gain expertise from working in the Consortium.
  - -- Gain cooperative support for future enhancements. The sharing of knowledge and resources will help with future enhancements or modifications.

D. HOW WAS THE CONSORTIUM FORMED?

- College leaders worked with legislators for funding.
- College leaders encouraged other colleges for support and participation.
- College leaders met to formalize the agreement and to develop the plan.
- College leaders agreed to form a vendor partnership to provide management expertise.

II. PROJECT SCOPE

The Florida Community College Software Consortium is seeking to enhance four mission critical systems as a first step in addressing the critical challenges. These Administrative Systems under development between February 1995 and January 1997 include Personnel/Payroll, Student Information, Financial Management, and Facilities.

- Personnel/Payroll includes: Applicant Tracking, Demographics, Job assignments, Benefits, Position Accounting, Payroll, Time Accounting, FTE Accounting, Data Base Transmission, and the General Interface.
- Student Information includes: Admissions, Registration, Records, Curriculum, Fees & Tuition, Degree Audit, Data Base Transmission, and the General Interface.
- Financial Management includes: General Ledger, Purchasing/Receiving, Accounts Receivable, Accounts Payable, Budget, Data Base Transmission, and the General Interface.
- Facilities includes: Inventory, Scheduling, Data Base Transmission, and the General Interface.

The software tools used to develop the applications are NATURAL, CONSTRUCT, and PREDICT. The data base of choice is ADABAS. Other data bases may be used provided that the version of NATURAL employed provides an ADABAS view of the data and supports most ADABAS data functionality. The systems being developed are being tested on the MVS, VSE, and AS/400 platforms.

III. PROJECT ADMINISTRATION

Developing four baseline applications is a complex task being carried out over a two-year period. In order to make sure that the desired results are obtained within the time frame and budget specified, a carefully structured business plan was implemented. The following section describes the major steps that were necessary to achieve the results described in this proposal.

1. Created Executive Committee

An Executive Committee was formed with one member from each college, as appointed by the Presidents of the respective colleges.

The Executive Committee is responsible for:

- Reviewing business plans.
- Setting priorities and directions.
- Developing Consortium project plan.

- Assigning appropriate personnel to teams.
- Overall administration and supervision of the Consortium.

The chair is responsible for coordinating all Executive Committee activities. The fiscal agent is responsible for handling all financial aspects of the Project, including all required reporting. The Executive Committee hired a Project Director who shall assume day-to-day responsibility for refining and implementing the overall systems development plan. The Committee meets regularly to review project progress, provide guidance, and help resolve issues. Committee members represent the interests of their respective colleges in obtaining the goals of the consortium. The Committee approves all expenditures of funds prior to disbursement by the fiscal agent.

2. Selected a Technical Committee

The Executive Committee established a Technical Committee with one representative from each college. The responsibilities of this committee are to provide technical expertise and support for the Executive Committee and to act as direct liaison with the Project Director.

3. Selected End User Representatives

The Executive Committee selected a group of end user representatives to serve as functional analysts for each application. One representative and approved participants was selected from each member institution for each application or component of an application.

The functional analysts shall provide information about State, Federal, and Consortium requirements for each application. They shall work with Consortium and Software AG technical experts to design systems which meet all of the above. The functional analysts, who are the users, have the primary responsibility for ensuring that the finished systems meet desired goals. They are the ARCHITECT of the software.

4. Developed Final Project Plan

The Executive Committee has developed a high level Project Plan. This plan defines the major components of each application, establishes development priorities, and schedules major project milestones and deliverables. This plan provides organizational guidance for the production of the project.

5. Established Electronic Connection

In order to assure action and complete participation in project development, each consortium member college is electronically connected with a minimum speed of 56KB. Connectivity also results in major savings through reduced travel. Consortium development is being accomplished using the computer facility at Miami-Dade Community College.

6. Rapid Application Development (RAD)

The Consortium selected RAD as the development methodology of choice. "RAD (Rapid Application Development) refers to a development lifecycle designed to give much faster development and higher-quality results than those achieved with the traditional lifecycle." James Martin, _Rapid Application Development_.

7. Created RAD Teams

Consortium and Software AG system design experts are assigned to work with each group of functional analysts, users. Software AG staff is thoroughly familiar with the techniques of RAD. Each RAD team combines extensive knowledge of the application, provided by the functional analysts, with strong technical expertise of the system design experts. This ensures that the final systems are technically sound, meet user requirements, and can be modified and maintained for the future.

8. Held Joint Requirement Planning Sessions

The first task for each RAD team was to participate in a Joint Requirement Planning session. This session was coordinated by a Software AG project manager. The objectives of this session included:

- Defining the scope of the project (defining what was to be accomplished).
- Defining high level system requirements.
- Developing an application "build plan".

All of the above was reviewed and approved by the Technical Committee. During this stage, Software AG conducted FASTRACK training sessions to facilitate the prototype development and to train Consortium technical staff.

STEPS 9 THRU 13 ARE IN THE FINAL PHASES OF COMPLETION.

9. Hold Joint Application Design Sessions (JAD)

JAD sessions are held for each of the major application areas. The purpose of these sessions is to further refine the requirements begun during the Joint Requirement Planning sessions. During these sessions, functional analysts, working under the guidance of Software AG experts, define the data each application needs to capture. Relationships between data are explored and clarified. The relationships and flow of information among organizational units within each college is defined so that relationships among applications are understood.

The first JAD session for each application area lasts about five days and includes the development of the following:

- Entity Relationship Diagrams, showing what information needs to be collected and how it is related to other information.
- Process Flow Diagrams showing how business is processed among the components of the organization.

10. Develop Application Prototypes

JAD sessions produce sufficient data about each application to enable Consortium and Software AG technical staff to quickly develop system prototypes. Software AG technical staff have certain assigned responsibilities for developing applications and management. Application prototypes are built quickly, incorporating only high level requirements as the goal of this first round of prototyping is to ensure that development is progressing correctly. If the development direction needs to be adjusted, it is done at an early stage with little loss of investment.

11. Evaluate Application Prototypes

Once each application prototype is completed, it is presented to the functional analysts for review and approval. Other members of the Consortium may also be asked to participate.

These prototypes are reviewed to determine requirements such as the following:

- All required data elements are present.
- The screens are well designed.
- Navigation is appropriate and easy to use.
- All required functions are present.

12. Hold Additional Joint Application Design Sessions

The comments from the prototype review are incorporated into subsequent JAD sessions. During these JAD sessions, requirements are further refined and additional details shall be added. Again, these sessions are conducted under the direction of Software AG experts using the knowledge and expertise of the functional analysts. Unlike the first JAD session, these sessions last one to two days.

13. Revise Application Prototypes Until Complete

After each round of prototype evaluation and JAD sessions, Consortium and Software AG technical staff enhance the prototype so that it meets the additional requirements as needed. Approximately 6 to 9 rounds, or iterations, are required to develop an application ready for implementation.

14. Approval of Applications

As the baseline modules are being completed, in addition to being tested on the development platform, they are being cross-tested at a designated site for each different platform/operating system environment within the consortium to ensure full portability of common baseline code. The Quality Assurance Director is responsible for ensuring the completion of this task. Testing of batch processes (jobs) require that operating system control language procedures (JCL) be converted/developed for each environment. These different control language procedure (JCL) versions then become a part of the baseline applications for the repository and future consortium maintenance. The completed baselines are approved by the Technical Committee to ensure compliance with established technical standards. The approved products are then certified by the Executive Committee chair to the fiscal agent for payment.

15. Install Applications In Central Repository

Once each application has been completed, it will be installed in a central repository. The repository will be the location where all the baseline applications are stored and maintained. From this central location, subsequent versions of program modules shall be distributed to Consortium members. The repository site has not been finalized. It may be at one of the Consortium colleges, or as an alternative, it could be located at Software AG's corporate headquarters, located in Reston, VA.

16. Distribute Applications

The next step in the process is to distribute applications to the member colleges. Each college shall get the same set of programs for each application.

17. Customize Applications

Once each college has installed the baseline applications, a functional analyst shall provide an application walk-through for interested staff. No customization shall be needed to meet State and Federal mandates. However, customization may be needed to meet specific college requirements. For example, this could include interfacing the new systems to subsystems, equipment (i.e., POS Terminals), and/or other applications existing at the institution.

18. Train End Users

High quality end user training is absolutely essential to achieving system goals and objectives. Training design shall begin during the latter JAD sessions.

19. Maintain Applications

Maintenance of an application is a critical, though often overlooked, aspect of system planning. By developing baseline applications that meet shared requirements, the FCCSC shall create an information processing environment which minimizes the effort required for maintenance. As State, Federal, or Consortium requirements change, the baseline applications and associated documentation will be modified at the central repository. Consortium colleges may assign resources to maintenance teams to make the required modifications. These modifications with documentation will then be distributed to all Consortium members. Thus, teams will be able to keep all Consortium members in compliance with mandates.

IV. THE PROJECT ORGANIZATION

A. CONSORTIUM AND VENDOR PARTNERSHIP

The project has been set up as a partnership between FCCSC and Software AG. Each staff member allocated by FCCSC is regarded as an equal member of the project team and schedules tasks accordingly. SAG has undertaken the management role, supplying a project director, a QA director, data base manager, three project managers, technical project leaders and information specialists.

It is for this reason that SAG will apply strict project management at all times and will need the total commitment from the FCCSC management team. The management of the day-to-day activities on the project is the responsibility of the Project Managers and they in turn are managed and directed by the Project Director. FCCSC staff are assigned tasks by the Project Managers and are expected to complete the assigned tasks competently. Non-task-related management issues, such as performance, attendance, leave and other problems are performed by the Technical Committee members, with input from the project managers.

B. ORGANIZATION AND FUNCTION

Some of the following were described earlier in III Project Administration # 1- 3, but again will be highlighted here.

Executive Committee	The Executive Committee has the overall authority for the project. They are responsible for reviewing business plans, and setting priorities and directions. They have the final approval for the allocation of resources, funds and personnel; the progress of the overall project; and changes that must be made to the project plan.
Technical Committee	The Technical Committee provides support for the

Executive Committee by handling month-to-month authority, performing technical oversight, assuring adequate resources on the projects. They also act as the direct liaison with the Project Director.

Project Director — The Project Director has the day-to-day responsibility f or refining and implementing the overall plan, managing the project, maintaining the project budget, and reporting progress to the Executive and Technical Committees.

Quality Assurance Director — The Quality Assurance Director reports to the Project Director and is responsible for coordination across all applications and the portability of baselines across all platforms. As baseline systems are customized for Consortium members, the QA Director will ensure the applications remain maintainable.

Data Base Administrator — The Data Base Administrator reports to the Project Director and is responsible for designing data base and file structures which support efficient processing for each application while also observing restrictions and limitations of versions of NATURAL which support most, but not all, ADABAS data functionality to ensure cross platform compatibility.

Project Manager — The development of each application shall be directed by a Project manager. The Project Manager reports to the Project Director and is fully responsible for overseeing the day-to-day operation of the development of an application, i.e., the student system.

Information Specialist — The role of the Information Specialist is to provide programming support, provide technical expertise, and to provide systems support. Each application shall have access to a lead information specialist from Software AG. This person reports to the Project Manager for the system and ensures the appropriate use of Software AG tools.

Users, the ARCHITECT — USERS ARE NO LONGER ONLY CONSULTANTS; THEY ARE FUNCTIONAL ANALYSTS, THE ARCHITECT! The User Representatives are functional experts, from the colleges, who are throughly familiar with the requirements for an application. It is the User Representative's primary responsibility to ensure that the final applications meet all State, Federal, and Consortium common requirements. They provide systems specifications, create consensus on issue

resolution, review development, test products, provide user documentation, and train secondary staff.

Development Teams — Development Teams are comprised of Consortium and Software AG technical staff as appropriate. Their tasks are to implement the results of the JAD sessions. They work with the User Representatives to create and enhance application prototypes.

C. RESOURCE SUMMARY

The following summary of resources shows the level of commitment of top management from the member colleges. Yes, new funding, which served as an incentive to begin the project, was provided by the State. This new money, mostly used to fund costs for the SAG partnership, covers only a portion of the costs. The college dollars and personnel are being allocated from current resources by shifting priorities.

PERSONNEL	NUMBER	
-- Colleges Technical Staff	27	F/T
-- Colleges User representatives	120+	P/T (10 - 50%)
-- Software AG staff	19	F/T
FINANCIAL (estimated cost to complete)		
-- Colleges	$11.3 million	
-- State	$2.7 million	

V. CRITICAL SUCCESS FACTORS

The Florida Community College Consortium and Software AG partnership is committed to meeting the State integrated data base requirements, within the resources and directions provided, using the following:

- Cost-effective application development.
- Fully functional applications delivered in less time than with traditional approaches.
- Protection of the Consortium investment should members need to change technical platforms.
- Reduced maintenance costs.
- Applications which can easily be modified to meet ever-changing regulations.
- Effective training for consortium technical staff.

The project will be successful when the following criteria is met:

- Completion of the applications under development within budget and on time.
- Systems to satisfy the user requirements within the scope of the baseline.
- Cross-platform compatibility for all systems (MVS, VSE, AS/400).

- Properly trained users.
- Detailed documentation.

VI. RESULTS AND DIRECTIONS

A. RESULTS OF THE ENGINEERING PROCESS

- Users are the architect of their Information Systems.
  - -- Users become the owners of their systems and data and become their own systems experts.
- Fully integrated applications are delivered in dramatically less time.
- Application development is more cost-effective.
- Investments in applications are protected across multiple platforms (MVS, VSE, AS/400).
- Application maintenance costs are reduced.
- Technical expertise is provided by vendors.
- Technical staff are expert at application development.

B. ACCOMPLISHMENTS DECEMBER 1994 TO PRESENT

- Plan defined, accepted, and funded.
- Contracts signed.
- Staff organized and in place--SAG and FCCSC.
- Eight colleges inter-communicating.
- Miami-Dade Community College development site operational and used for all development.
- High-level specifications defined for all systems.
- Detail specifications were developed for the Personnel/Payroll, Student Information (Admissions, Registration, Curriculum, Fees and Tuition), Financial Management, and Facilities.
- Construction for the Personnel/Payroll, Student Information (Admissions, Registration, Curriculum, Fees and Tuition) and Financial Management is on schedule for completion December 1995.
- College Implementation/ Steering Committees beginning to meet.

C. UPCOMING CHALLENGES

- Holding to the development plan's scope, time and budget.
- Implementation of the applications under development.
- The future after this baseline development is complete.
  - -- To continue funding.
  - -- To continue commitment of staff resources (business and technical) to the FCCSC by its member colleges.
  - -- To continue commitment to the RAD process.
  - -- To finalize plans for the Consortium organization, for future enhancements and maintenance.
  - -- To develop the financial aid component.
  - -- To integrate the library database component.

D. CONCLUSION

This project is already a success in that eight very diverse community colleges are working and sharing together. It will continue to be successful because, along with the enthusiasm of the colleges and the need and desire for the products, this project has three criteria required for success. They are:

- --- The project must be organized and managed so successes occur along the way, not just at the end. RAD is our methodology.
- --- The project must have support and direct involvement of the users. Our users are the ARCHITECT.
- --- The project must have top management support. Look at the commitment of the college resources by top management. They are committed!

Our dynamics and momentum are strong! Every member college believes in our success!

Wireless Networking at Ohio State University

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As networking becomes increasingly complicated and expensive, so does the decision-making process. The decision to go wireless can be even more complicated. This presentation will discuss Ohio State's current status, connectivity problems, planned solutions, and describe the network and its capabilities.

Wireless Networking at Ohio State University

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Current Status

We now have 10 point-to-point wireless links running ethernet from the campus to outlying off-campus buildings where it is not practical to provide fiber connections. We are seriously considering adding a Metricom wireless network for use by end users.

Current Campus Connectivity Problems

Like most campuses, we have no wireless connectivity for portable computers, the dial-in telephone modems are overloaded, the open student computing labs are overloaded, and the computing budget and staff are decreasing.

Planned Solutions

The dial-in modem pool is being increased to 672, and its usage is being rationed. Part of the pool will allow only 30-minute connections, and the rest is unlimited. We are also planning to install a Metricom wireless network, to provide at least some assistance in relieving future overloads and provide better user service. It must be clearly understood that a wireless network is only a supplement to a good wired network; it cannot be used alone since it cannot have sufficient speed or capacity.

Why Metricom?

You could design and install your own wireless network, by purchasing wireless equipment from a number of vendors in the field. This could provide greater speed than what Metricom offers, but no University has fully done this as yet. The cost of such a network would be comparable to a wired network, both initially and ongoing. Metricom is alone today in providing a different alternative. They will install the entire network at no cost and then charge the end user for using it. This is a classical outsourcing situation.

What does the network look like?

Metricom installs antennas and radios on rooftops or streetlight poles throughout the campus and all surrounding university areas, such as fraternities, sororities, apartments, etc. Users buy or rent a small radio modem which functions exactly like a dial-in modem. No special software is required. The user may use any software which supports a PPP connection over a dial line. Any kind of user computer may be used. The wireless network functions transparently, allowing all usual Internet functions such as telnet, FTP, WWW etc.

Metricom Wireless Network Capabilities

About 30 kilobits/sec connection to campus wired network. We have measured this doing FTP between two portables, in a point-to-point mode.
Connects all portables anywhere on and near the campus.
Connects desktop computers in unwired dorms.
Connects desktop computers in off-campus housing areas.
Connects portables in and near your home.

If you live miles from the campus, you can do this with two radio modems in your home. One connects to your telephone, the other to your portable out on the patio.

Connects portables while traveling away from campus.
All Metricom campus networks throughout the country are connected together via Metricom's private Internet. Hence you can access your home campus while visiting any other site where a Metricom network is installed.

Connects computers via private networks. Any computers within radio range can communicate directly with one another, without using the campus wired network.

Costs

Metricom:
Installation, monitoring, maintenance, and expansion of the network as needed.
End-User support, via 800 number, Email and on-line BBS.

University:
Electrical outlets and electricity, connections to the wired campus network, and the staff time to work with Metricom in planning.

End-User:
$245 one-time and $20/month. Free Summer vacation. You own the radio.
OR
$45 one-time and $30/month. Free Summer vacation. You rent it.

Campus Computer Store:
Earns $45 commission on each sale.

For Further Information -
Many campuses are now installing Metricom networks. Some of the early ones are Stanford, Austin, UC Santa Cruz, Oregon, Oregon State, Miami, Indiana, Illinois, Clemson. There is a discussion list where current and prospective users compare notes, and the archives of all past comments are available. To subscribe, send email to:

listserver@lists.acs.ohio-state.edu
Leave the subject blank.
In the text, say ONLY this:
subscribe metricom yourfirstname yourlastname

You will then receive introductory information, instructions on retrieving past postings, and all future postings.

Merging of Voice, Video, and Data Over a Single Cabling Infrastructure

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A detailed description of the construction methodology to integrate into a single project the design, construction phase, and operations of a residence hall rewiring project. This project provides full 82 channel video capacity with educational and entertainment offerings, 10 base-T Ethernet connectivity to the desktop, Category 5 UPT cable, and RG-6 coaxial cable.

The combination of using multimode fiber in all building riser systems, horizontal Category 5 cable within 300 feet of any intermediate distribution closet, and single mode fiber for campus-wide distribution will be described and slides depicting the installation process will be provided.

The use of composite cable with an approved UL sheath reduced the labor costs on the overall project by one-third. The composite cable consists of two four pair Category 5 cables and one RG-6 coaxial cable terminated in a multiport jack.

The cable television portion of the project will be outlined including the use of a unique PC based addressable tap system used to control customer turn on and turn off as well as tier selection of program offerings.

Duke University is a private institution located in Durham, North Carolina, on approximately 8,000 acres of property with 6,000 undergraduate students, 3,500 graduate and professional students, and employs over 22,000 employees at the University and Medical Center. Duke University is a relatively new university being founded in 1925 through an endowment of the Duke family. Many of the buildings were constructed during that era which included most of the campus quad, residential areas, dining facilities, and the classroom buildings.

Duke University Tele/Video Department is charged with the responsibility of furnishing voice, video, and data connectivity to the campus and the Medical Center. We presently operate a AT&T #5ESS Central Office Switch with 18,800 lines in service. Included in the 18,800 lines are approximately 5,500 basic rate interface ISDN lines serving our academic and administrative areas.

In 1992 after much discussion and debate, it was decided that Duke should improve the intrabuilding wiring structure to upgrade its older and undersized copper wiring plant which carried voice and data over it. At that time, there was a modest cable television distribution system on campus utilizing a coaxial cable network distribution and RG-59 intrabuilding wiring into some commons areas of residence halls and a few administrative areas and meeting rooms. However, it was under funded and did not have a significant channel offering. The students of Duke University were very interested in increasing the availability of cable TV into the dormitory rooms and enhancing the entertainment channels available to them. It was through this interest and desire by the academic areas to enhance data connectivity, that the intrabuilding wiring project was launched in 1992.

There was extensive design work provided in developing an RFP to be sent out to various vendors to bid on the construction and operation of a CATV system. At the same time that the construction of the CATV system was to be undertaken, a category 5 copper cable plant enhancement was to be installed concurrently with RG-6 for cable TV and category 3 cable for telephony use. The bidders had some extreme concern with the various types of difficult construction that needed to be accomplished on the Duke campus which included older Gothic buildings as well as several asbestos laden frame buildings that needed to be wired. The results of the bids were inconclusive in that out of nine invited bidders only two chose to respond. One was at $6M and the other $3.8M to wire 3,400 rooms in the campus network. Duke Tele/Video estimated the work to cost $3.2M.

Duke University Tele/Video Communications decided that it would take on the project internally and act as a general contractor hiring electrical firms qualified in wiring the residence halls to proceed with the work. The other logistical problems beside the construction constraints were the logistics imposed by the use of the housing facilities almost on a twelve month basis. Special arrangements had to be made to coordinate with Housing available times that major work could be performed within the residence hall facilities. The Board of Trustees approved the project and permitted internal borrowing and the repayment schedule.

In the first summer of 1993, much of the work was done in unused residence halls and moved relatively smoothly. We were able to provide wiring for approximately 1,200 rooms the first summer. The whole project was estimated to cost $3.2M when done under the auspices of Duke University Tele/Video Communications. This included the actual purchase of wire, labor, closet construction, outlets, miscellaneous materials and the basic electronics for a 10 base-T Ethernet distribution system to each residence hall room. The basic equipment was provided by our Data Communications Department under another project, but it was only for building a single entry piece of data equipment and did not include intermediate and other data equipment requirements. The DukeNet project did, however, provide the fiber based connectivity to all of the residence halls and the cable system was designed around a fiber distribution system with fiber transmitters serving eighty per cent of the construction locations. Also multimode fiber was pulled into the new closets on all floors of the residence halls so that no data outlet was more than 300 feet from fiber distribution or its associated electronics. As was mentioned, the total cost of the project through Tele/Video Communications was $3.2M and included the construction of complete CATV headend including a 160 foot tower and eight satellite dishes for programming reception.

The second year of construction accelerated the project and the headend was complete as well as an additional 1,500 rooms completed. Both in the summer and throughout the academic year we were able to make considerable arrangements with Housing to work over break periods and vacation slots and were to accelerate the project. In August of 1994 our new headend was complete and a 33 channel entertainment system was put into place. The students reacted enthusiastically to the availability of this enhanced programming. We were able to meet our projected sign-up rate to support the entire project fiscally for repayment. The $3.2M authorized by the Board of Trustees is to be repaid over a fifteen year amortization period, and we anticipated the first three years to be in a deficit position. The entire fiscal plan was built on a 40% sign-up rate at the $19.85 per room charge for entertainment and academic cable TV.

The first year sign-up was a very encouraging 55% of our entire residential student body at that level. There was desire on the part of many academics to provide "educational tier programming" that would be academic in nature and would be available to the majority of the student body both in the commons rooms, classrooms, and lobbies for viewing at a very low rate. It was decided that we would dedicate the first twelve channels on the system to this educational programming in order to provide for this need at a level of only $5.00 per month. This was subsequently dubbed our "EdNet" tier and our entertainment tier was appropriately named "DevilVision".

Because of this channel mix requirement, a simple way to provide this for people who wanted just the lower tier required the addition of an addressable tap system. We investigated several companies that provided an addressable tap system and found that most were geared towards a residential type system that you would find in a residential community. There was, however, one company that looked at an apartment type or residence hall type group housing and provided units that were designed for bulk addressable tap equipment. These were built-in units of eight, twelve, and sixteen which could be grouped together in larger residence hall closets in order to provide a true addressable tap system at the residence hall location. This addressable tap system

would allow an operator from a standard PC located in the CATV office of Tele/Video Communications to initiate service from the PC over the carrier wire to the addressable tap and signal it through a series of digital commands. This would allow the operator to turn the signal on, turn the signal off, provide tiers of service whether it be EdNet, DevilVision, or our premium tiers which include such channels as HBO, Showtime, or Home Team Sports. This made the whole operation very efficient and provided very little truck roll or installation crew requirement to visit the residence halls to adjust for tier purchases or tier assignment. The additional cost of the addressable tap system will be quickly recovered within a two year period on savings of maintenance and truck roll. It was a very ingenious solution to a difficult requirement.

We decided to have two local originating channels from Duke Tele/Video inserted onto the system. We have a dedicated channel 5 which we have named the academic channel. We provide at no cost redistribution of the faculty members requested video tapes, specialized copyrighted material that has been cleared for redistribution and some live interviews on academic matters. In addition, we use it as a public service channel announcing Public Safety reports, use of emergency phones, computer hook-up instructions and specialized downlinks of an academic nature from time-to-time from around the country and the world. This has proved to be a very valuable information outlet for the University in general and is utilized continually.

Our second local channel is known as channel 31 and is our "movie channel". We have entered into separate contractual arrangements with mo suppliers to provide first run movies on this dedicated channel originating from the Tele/Video CATV office. In that office is a piece of equipment that is designed for multi tape playback and for graphic interaction on the screen with various graphics indicating time and date for the movie production. These are timed out and require little intervention on the part of the operator. There are twenty movies per month available on channel 31 and they are repeated throughout the month at various times throughout the day and evening so that the subscriber can see these movies at their convenience. It is proven to be very popular channels with the students, and we honor many of their requests for first line movies.

We were also fortunate during the construction of our satellite farm to receive a special grant from the Political Science Department authorizing us to construct a large 6 1/2 meter dish to bring in a direct feed from Moscow for the TV Network from Russia. This was a very difficult construction project since the Russian satellite being utilized is only eleven degrees above the horizon and has a definite wobble in its orbit. Therefore, the dish was mechanically constructed not only to lock on to the satellite with a laser pointer but it had to have additional motors installed so that the satellite dish could actually move with the wobbling of the Russian satellite. The quality of the picture is excellent considering those constraints. We distribute the Russian signal over our channel 43 for our students. This has proven very popular with our foreign language majors and visiting graduate Russian students and others who find the Russian programming to be very timely and appropriate.

We have also been traditionally involved with SCOLA, the foreign language broadcasting network which we have placed on our educational tier and is again very popular with the foreign

language majors and provides language broadcasts from numerous countries around the world. Our Russian satellite signal quality is of such value that we tape much of the Russian programming and send our tapes to McClellen, Iowa where the SCOLA network actually uses Duke University's tapes for much of their rebroadcast of the Russian network to their 3,500 world-wide downlink subscribers.

The construction of this total project was a difficult one, but we were very proud of the results. We have utilized a double gang outlet with two RJ-11 jacks, two RJ-45 jacks, and an RG-6 CATV outlet in each box located in each residence hall. There are some examples where there are single gang outlets in residence halls where there has been remodeling completed by the Housing Department and in two new residence halls constructed during the project. In those instances, each side of the room had their own single gang outlet with one RJ-11 jack, one RJ-45, and one CATV RG-6 outlet. However, the RG-6 outlets are grouped together at the intermediate closet location and has a single addressable tap unit. If students sign-up for CATV in the room they have two working outlets but only pay for one subscription.

We also had other difficult construction constraints in other locations in the University beside the Gothic architecture. We have a group of 515 apartments in a complex known as Central Campus Apartments which were built with Federal funds over thirty years previously. They were wired into the living room for telephony only and had no bedroom outlets of any kind. We made the decision to extend our standard wiring into each of the bedrooms as well as the living room and provide additional data, voice, and video connectivity in each of the bedrooms. Because of these extensive wiring requirements there were no interior building closet spaces available in any of these structures. A very unique design was utilized to provide this connectivity. In many cases, exterior wall chases were developed so that cable could be pulled up through an attic area and down through an exterior wall chase into a separate building structure that was air conditioned and housed the data equipment and CATV amplification equipment for several buildings. These structures had to be approved by an Architectural Design Committee on campus and were designed to resemble the Central Campus facilities and did not stand out against the other type of architecture in this particular area. It did require a great deal of trenching and a great deal of conduit pulls to provide the interconnectivity for the Central Campus Buildings. This was the most expensive part of the rewiring project but has proven to be a good decision in extending the number of outlets required into the bedroom areas.

The success of twiring project is very evident from the rapidly growing direct 10 Base-T Ethernet connectivity experienced in the residence halls. During the first year of availability of this type of connectivity only 550 students of the 1,200 outlets that were available took advantage of a direct connection to the fiber backbone and 10 Base-T Ethernet speed capability. However, this past academic year with the wiring complete with 3,400 rooms available for connectivity, over 2,200 students have been directly connected to the network. The others, of course, still have dial-up modem capability but we are encouraging them to directly connect to the backbone. Each incoming student is automatically given an e-mail address and is automatically included in the campus directory with their e-mail addresses provided on a campus-wide basis. The popularity of the use of their connections is obvious from the traffic patterns generated on our data network.

In addition, their phone service is on a voluntary basis and we have a 98.1% sign-up rate for all residence halls on campus. The direct connection to the Internet has not diminished the demand for telephone service, voice mail, or other services provided on the telephony side. The sign-up of CATV has also exceeded our projected goals with over 1,750 sign-up for the DevilVision tier this current semester including over 350 premium subscribers.

All of the subscribed services are provided under one merged Office of Information Technology. Our new Vice Provost for Information Technology, Betty Le Compagnon, arrived on campus on October, 1994, and was extremely anxious to merge and enhance the overlapping services provided various departments on campus. The reorganization has provided a mechanism to address all of the challenges of merging voice, video, and data together under one organization. It has proven to be very successful during the past year. She has taken on the additional initiative of presenting to the Board of Trustees in May, 1995, A $15M project to complete the rewiring effort in the residence halls and provide a similar project in the rest of the 167 academic and administrative buildings on the Duke University campus. This will be a four-year phased approach to the rewiring and we have initially begun the first year of the intrabuilding wiring project for the academic and administrative facilities. A similar wiring design is being utilized which includes 4 pair Category 5 both for voice and data, RG-6 coaxial cable and in some cases dark multi mode fiber to the desktop. This will be deployed in the School of Engineering which consists of three buildings which will have the standard wiring plan plus dark fiber pulled with the cable to the outlet in each engineering facility unterminated at the outlet and closet end. No electronics will be provided at this time. However, in the immediate future with the requirement for higher and higher speeds the dark fiber could be activated and the labor saved at this time will be realized at that time.

The Intrabuilding Academic Wiring Project will cover some 167 buildings when it is complete and will provide the 10 Base-T Ethernet connectivity presently used and will have capability of 100 megabit switched Ethernet and higher. Again, the general scheme is to develop closet spaces no more than 300 feet from any outlet and 300 feet from any electronic background equipment. The fiber optic ring is complete for the entire campus network and is operating well at the present time. We are moving up to FDDI capabilities on the ring as well as 10 Base-T Ethernet. It also supports some current 4 megabit token ring and 16 megabit token ring LANS which are slowly being phased into the Ethernet world.

When this massive project is complete, we hope to bring Duke University up to a general standard that is flexible, and can migrate to higher connectivity speeds as we move forward in the data world. It also provides video capability to most areas and provides a pathway so that any new technology that does develop such as ATM can be accommodated. For the future, our infrastructure will be in a position to migrate to these new technologies without the massive replacement and construction that we have had to endure during this project.

We also see the potential for wireless technology developing and do not discount the possibility that wireless can provide data connectivity on a very ubiquitous campus-wide basis. However, our investment in the infrastructure I have described will have a definite usage life of ten to

fifteen years or more and provides the ability for higher speeds that are anticipated in the wireless world with continuing lowering of electronic costs for direct connection. The use of surface mount conduit and above ceiling open wiring troughs will allow us the flexibility to allow additional specialized cable that may develop as technology moves forward. We feel that at Duke University we have provided a plan of structure and action to bring Duke University into the 21st century of technology.

A Cooperative Approach to Document Imaging, Storage and Retrieval

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Abstract

The immediate objective of the St. Mary's University Document imaging project is to provide the Office of Financial Assistance with the ability to scan, store, index, retrieve, view and print the images of documents they receive.

The overall objective of this project is to provide this same ability to a number of departments within the University. Those departments would include, Admission, University Relations, Registrar, Academic Advising and the Comptroller's Office. We will integrate document images stored on the system within the University's administrative database system provided by CARS Information Systems. This will link them directly to the rest of the database information maintained on an individual or entity. This will also allow viewing of an image by any users connected to the University's Ethernet Network, provided we grant view privileges to that person.

We need to accomplish this with minimal financial and staff resources by working cooperatively with existing vendors to benefit all parties.

I. BACKGROUND

St. Mary's University is a comprehensive, private university in San Antonio, TX with an enrollment of approximately 4100 students.

Our Office of Financial Assistance processes Financial Aid application on approximately 3300 of those students each financial aid year. During a year the office will receive approximately 85,000 - 90,000 documents per year. These documents include things such as student and parent tax forms, financial aid transcripts from other institutions and financial aid verification forms.

Each year the financial aid office is spending $3500 -- $4000 dollars to have these documents microfilmed. In addition they keep approximately 350,000 to 400,000 hard copy documents in file folders stored within this office space.

II. PROBLEM

With limited physical space and the high demand for quick access to these documents the current manual filing system has become woefully inadequate to support the needs of the Financial Aid Office.

We needed to replace the current system with a technology solution in a short time frame and that fit into a limited budget.

III. APPROACH TO SOLUTION

We knew our solution would be to implement some form of on-line storage of the documents. The biggest drawback to this solution was being able to bring document imaging and storage on campus with the limited resources available.

I was sure that we did not want to bring in a totally new vendor into our current mix to handle this need. I have heard and read many horror stories about other institutions that have tried to effectively integrate document imaging systems into their existing networks and databases. In addition to the networking and software integration issues, We needed our document imaging solution to meet our work flow demands from a user interface point of view.

Our desire is to have an application that works the way our offices process the paper and to eliminate as may keystrokes and steps in the process as possible. The only solution to this was to leverage our long term relationship with our current administrative software supplier and work out an arrangement that was beneficial to both parties.

During the CAUSE94 conference I discuss this issue with our administrative software provider CARS Information Systems. We began exploring the possibility of a joint project to introduce document imaging into their product.

I was willing to commit a reasonable amount of our University's resources to the project. This project would produce the basis for a generic document imaging application that integrates with our existing software systems and will be used by all administrative operations with the need for document management. In addition to a limited monetary commitment the University would provide the necessary user input into the design and specifications for the application. We also would commitment to purchase the necessary equipment and to allow our vendor access to that equipment for development purposes.

The biggest hurdle to overcome at most institutions for this type of project is to secure the funds and authorization for this project from the University's Executive Council and the President.

The first step in this process was to work with our vendor and identify as close as possible what the costs would be for this project. Internally I began to meet with the Director of Financial Assistance and the VP of Enrollment Management to determine just what they could afford to do within current budgetary constraints. We also took this opportunity to reiterate that this project would have a long term benefit to all administrative operation within the University. This was a very important step in laying the ground work for project approval with the Executive Council.

Our discussions with the Director and VP helped identify the fact that they did have money set aside for the purchase of a new filing system and for micro filming of existing documents. We made the determination to redirect a portion of those funds to this project. The Administrative Computer System budget would be able to provide $10,000 from moneys ear-marked for special development projects that were still available.

Once we determined what the available resources were and established strong support for the project across the University, we worked in cooperation with our vendor to establish costs for the project. That cost including hardware, software and miscellaneous expenses came to $33,600 (see appendix A). The funding breakdown is a follows; $10,000 from the Administrative Computer Systems budget, $2,000 from the current Financial Aid micro filming budget and the balance of $21,600 from a pool of excess revenues over expenditures at the end of the fiscal year. This money was approved by the Executive Council after we presented the overall benefits of the project.

Our vendor was very open to this cooperative approach and understood our budgetary limitations. They also were receiving many inquiries from other clients about imaging application and therefore had reason to want work cooperatively with a client on the initial application.

IV. PROJECT OVERVIEW

The initial objective of the Document Imaging Project will be to provide the Office of Financial Assistance with the ability to scan, store, retrieve, view and print the images of documents received by that office. This capability will provide 3 main benefits to the Office of Financial Assistance.

1. **Saving of Space, the scanning and storage of document images electronically would eliminate the need to file and store the hard copy document within the small confines of the Office of Financial Assistance.**
2. **The ability to retrieve the documents of a particular student would be easy, fast, and available to multiple people simultaneously. Also we eliminate the time spent searching for misplaced or misfiled folders.**
3. **The ability to make backup documents and store the backup images at an off site facility. Most actual documents are not backed up because of the cost and amount of space required to store them.**

The overall objective of this project is to provide the ability of storing documents received by any department within the University. Those departments would include but not be limited to, Admission, University Relations, Registrar and the Comptrollers Office. We will integrate the document images stored on the system within the University's administrative database system, thereby linking them directly to the rest of the database information maintained on an individual or an entity. This would also allow viewing of any image by any users connected to the University's Ethernet Network provided we grant access to that person.

V. INITIAL DELIVERABLES:

The deliverables agreed to between St. Mary's and CARS Information Systems was to provide a system to handle the University's Office of Financial Assistance documents. This system will function in the following manner.

1. **As we receive documents, we collect them and take them to the scanning workstation. Here the operator will scan the documents and add indexing information via the workstation software.**

2. **We will return the documents to the person who will actually deal with them first. This person will retrieve the documents and verify image quality prior to the data from the document being entered into the system.**

3. **If the document later needed to be viewed or printed, then any user who has a networked PC connected to the CARS system will be able to call the document up and view or print it.**

VI. PREPARATION AND SETUP ISSUES:

The introduction of document imaging systems into the work environment requires those persons using the system to change the way the think about working with paper documents.

One of the most difficult concepts to get through to staff who will be utilizing the application is to resist the desire to print a hard copy of the document. A recent article in *Forbes ASAP* magazine raises the issues about how document imaging systems can actually increase the amount of paper used within an operation. In that article

> listen to Walter Jacobs, an engineer installing Lotus Notes groupware for James River's Pennington, Ala., production plant: "Human beings trust the printed word," Jacobs says, "that's something you'll never get away from."[1]

We found it necessary to work on changing these ingrain habits in order to achieve the maximum potential from an imaging system.

In introducing document imaging into an office you must work at changing the way in which staff work with information contained on these documents. Discussion about how documents will flow through the office are essential prior to the actual implementation of an imaging application.

We found that determining what is an acceptable quality of the document image is also an extremely important part for the setup and preparation of document imaging systems. This question relates directly to the issue having a cost effective imaging application. Although the cost of storage media is rapidly decreasing, the determination of what is an acceptable image to store weighs heavily on the amount of storage space you will require. A document scanned at 600 dpi will require six times the space as a document stored at 100 dpi.

Not only will the image cost more to store but it will alsocost more in terms of the time needed to actually scan, store, retrieve and print the document. You must weigh this carefully when trying to keep the cost of imaging to an acceptable level.

When preparing to implement an imaging application set aside time to identify the many documents that you will be scanning. By setting up tables that identify the size, number of pages and the image quality setting for each individual document, you will save time during the actual act of scanning the documents to be stored.

VII. TOOLS AND TECHNOLOGY:

We are not purchasing a packaged imaging system, but instead we are having the application developed by our administrative software vendor. I thought it would be beneficial to describe the software and hardware that we will use in this application.

On the software side CARS Information Systems is using *Visual Basic* as the proto-typing tool. Eventually this will probably be replaced by *Visual C++*. *Integrated Business Applications Builder* is being used to develop the GUI front end and for data access. The actual imaging and scanning libraries are from *Data Techniques*, utilizing *Intersolv's Data Direct ODBC Drivers*, specifically for Informix 5. We should note that all development is being done with OLE compatibility in mind.

On the hardware and networking side our Financial Aid office is connected to the university's Ethernet network and operates on a local Novell server. All workstations are 486 DX2 66mhz PC's with 8mb of memory. They utilize Novell's Lan Workplace to connect to our UNIX based administrative system.

The scanning workstation is a Pentiuim 100mhz PC with a 1.2 gigabyte hard drive and 16 megabytes of RAM. This machine is running Window for Workgroups and contains a SCSI host adaptor. We have connected a HP Scanjet 3C scanner and HP Laserjet 4M Plus printer to the system. We also have purchased a HP 20XT Optical Jukebox drive that contains 16, 1.2 gigabyte optical disks that is used to store the images. This drive will initially be connect to our host HP 847 administrative system but may eventually be moved to the local Novell server.

One of the early issues that we needed to address when planning this project was where, and in what manner, to store the scanned images. Our initial thoughts were to store the images in a database BLOB field. Our investigation of this option uncovered some very valuable pieces of information. First, in order to store the images within the database we would have to purchase additional software from Informix our database software vendor.

This software, *Informix Optical* presented a number of problems for us. First it was moderately expensive at a price of about $4000.00. Second this software would only support Write Once Read Many (WORM) access to the optical disk drive even though the disk itself was rewritable. Lastly we learned that Informix has no current plans to support the writing to CD-ROM in the near future. This was very important to us for the future since this likely will be the least expensive storage option that we will have in the future.

As we looked at our options we decided that the better direction to take was to store the images on the optical jukebox under the UNIX file systems. We will include just the indexing and pointer information in our database. In addition to providing us more flexibility we also feel that this will serve to increase the access time to the images and reduce the impact on the performance of our database.

VII. ACTUAL COSTS INCURRED:

One of the major reasons that St. Mary's was able to move ahead with this imaging project was the relatively low investment that we needed to put into it initially. This combined with the gains in productivity that we expect to achieve from the project make us believe that we made a smart decision in pushing for the funding of the project.

The final initial startup costs broke down in the following manner and you can compare them to the initial estimates as outlined in Appendix A.

• Imaging Workstation Hardware Pentium 100MHZ PC 16mb RAM, SCSI Adaptor, 1 Gig Hard Drive	$ 3,026
HP Laserjet 4mplus	$ 1,812
HP Scanjet 3C Scanner	$ 943
Auto Document Feeder	$ 471
• Pentuim Fileserver for Financial Aid Office	$ 2,639
• Modem on Imaging Workstation for support	$ 87
• HP 20XT Optical Disk Drive w/16 optical Disks and HP-PB SCSI-2 host adaptor	$ 7,047
• CIS Software Development	$12,000
• Misc Software(ODBC Drivers, Informix Net)	$ 2,142
• Travel Expenses for Installation and Training	$ 1,500
TOTAL	$31,667

We have brought this project in under the anticipated budget but actually spent the money on different items than was initially anticipated. You must also keep in mind that our Financial aid office had 486 DX2 PC's on the essential staffs' desktops prior to this projects undertaking. Obviously this would have increased the cost for this application had we had to purchase the workstations needed for viewing the stored images.

APPENDIX A

INITIAL HARDWARE AND SOFTWARE REQUIREMENTS AND BUDGET

The following outlines the Hardware and Software requirements for the initial phase of the Document Imaging Project. Outlined here are the minimum requirements.

• **Imaging Workstation to include (REQUIRED)**		**$ 7000**
1. Pentium PC, 90mhz, 16mb RAM, 1 GB hard drive, CD-ROM Drive, Network Card, 2mb Video, SCSI Card	$ 3,500	
2. Mid range simplex scanner, monochrome, accommodates 8-12 documents per minute	$2,000	
3. HP Laser Jet 4M Printer.	$1,500	
• **Imaging Engine -- (REQUIRED) For initial trials the recommendation is to utilize a software engine. However, depending upon document flow and volume a hardware engine may be warranted, especially if a faster scanner is utilized. Note these hardware engines do not add any necessary functionality, just increase scanning speed.**		**N/A**
• **CARS Provided Software -- (REQUIRED) including the workstation imaging software and the add-ons to the CARS platform necessary to index the images in the database.**		**$ 12,000**
• **Miscellaneous Software Licenses -- (REQUIRED) for scanning workstation, software for printing from any station and operating system software.**		**$ 2,000**
• **Optical Disk Drive 20 GB HP Erasable Optical Jukebox Model 20XT (C1100A). One System provides ability to store 200,000 Documents on-line**		**$ 7,100**
• **Informix On-line Optical Software to allow access to the optical disk drive. This software require a $825 annual maintenance cost. On the HP E55 maintenance is $510 annually**		**$ 4,000**
• **Travel Expense for Training by CARS**		**$ 1,500**
TOTAL PROJECT COST		**$ 33,600**

FOOTNOTES AND REFERENCES

Footnotes:

[1]Glen Rifkin, "The Future of the Document," Forbes ASAP, October 9, 1995, p. 44.

References:

Rifkin, Glen. "The Future of the Document." Forbes ASAP, October 9, 1995, pp. 42-60.

Object Think: A Step Toward Object Oriented Implementation

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ABSTRACT

Have you been caught up in the idea of Object Orientation? How do you get the team members of that first project to start the transition to Object Orientation: How do you guide the team to think in terms of objects or to "Object Think"? This presentation will examine how DePaul University applied this learning process to the introduction of Object Orientation. Discussion will center around the process that was used in the introduction of Object Orientation and how the topic was introduced without the technical jargon.

PowerPoint presentation available,
see http://cause-www.colorado.edu/conference/cause95/c95track-5.html

Application Delivery in the '90's: A Framework for Change

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Abstract

The approval of a multi-million dollar, 5-year strategic plan for replacing most administrative information systems causes a university's information technology department to rapidly learn new technologies, methods, and business practices. In order to most effectively deliver new systems, the I.S. department re-engineers to a provide project-based matrix management, a framework for "build vs. buy" decisions, application assembly and intergration, and project support and improvement.

Background

During the 80's and early 90's, Stanford University implemented a set of integrated administrative systems that were written in SPIRES, a proprietary fourth generation language developed and supported by Stanford staff. All forms were put on line, electronic signature and routing were implemented, and on-line approval from electronic mail was integrated into the work flow.

By the end of the 80's as we were completing the last of our major administrative systems, we were already beginning to see the need for change. The very factors that contributed to the success of the administrative systems at Stanford were now creating a new set of issues. Since paper forms had been eliminated, the mainframe capacity needed to support the University's administrative needs was growing rapidly. Our reliance on proprietary systems made it difficult to find the skills we needed in the marketplace. In the highly competitive Bay Area, it is difficult to find technical staff who are willing to learn non-transferable languages and proprietary systems. Existing SPIRES expertise was diminishing as staff retired or pursued other career opportunities.

Technology was also changing very rapidly. What were viewed as "state of the art" systems when we started creating systems in the 80's were already being viewed as out of date by the time we were delivering the later systems in our applications portfolio. Distributed, client/server systems utilizing graphical user interfaces were starting to be available in the marketplace. And, according to the wisdom of the times, these systems could provide the same functionality as mainframe systems much more cheaply and in a much more user-friendly manner.

The "business" climate was also starting to change. What had appeared to be an era of unlimited growth was rapidly coming to an end. There was increasing downward pressure on all sources of unrestricted revenue: tuition costs , indirect cost recovery, and unrestricted gifts.

The changing financial environment led to decreased base funding for computing and systems support. At the same time, there was an increased need for flexible systems to provide timely information and to respond to an increasing rate of change in business requirements.

Added to these pressures for change, for Stanford University, probably the most significant push for new, more flexible systems came as a result of the government's indirect cost investigation of the early '90's.. One of the findings of the investigation related to the inadequacies of the existing financial systems. Although the on-line systems created in the 80's provided capability to view information in the general ledger, and to perform some financial transactions, the central general ledger system was created in the 60's and was difficult to extend, had outgrown the original schema for the chart of accounts, made it difficult to close the books at fiscal year end, and was updated only monthly, making timely financial reporting extremely difficult

In 1991, it was determined that our core financial systems should be replaced for the functional reasons stated above, and increasingly, also for technology reasons.

The Change Process Begins

The first step (needless to say) was to re-organize the information systems staff. To provide a critical mass of resources to implement new systems, and to leverage economies of scale, a new centralized applications group was formed. This unit was called Business Information Systems Applications (BISA), and reported to the Chief Financial Officer. During the summer of 1993, an Administrative Systems Strategic Planning effort was launched under to sponsorship of the Chief Financial Officer, and led by the University Auditor. An AIS Planning team was formed with membership from the schools, central administration, BISA, and other technology support units on campus.

At this time the scope of the planning effort was extended to all administrative systems on campus. Concurrent with the AIS strategic planning effort, several business process improvement and/or re-engineering efforts were launched. The primary goal of these efforts was to eliminate non-value added activities and thereby reduce both central administrative costs , and administrative costs in the schools and departments.

The AIS planning effort concluded in the summer of 1994. Twenty-two major systems initiatives were identified, and scheduled for completion over a five year period. The Board of Trustees approved the plan, and projects were launched in September of 1994.

From Chaos Comes Knowledge

Knowledge can be divided into four categories: 1) what you know you know, 2) what you know you don't know, 3) what you don't know that you know, and 4) what you don't know that you don't know. In September of 1994, the number of items in category 2 seemed to far outnumber those in category 1. Over the past year, several items that were in category 4 have now moved into category 2. Category 3 represents the 'nice surprise': when you discover you know something that you weren't aware that you knew or didn't recognize the value of.

<u>Category One: What We Knew</u>

- The Board of Trustees had approved a high level 5-year systems plan, which outlined the need for 22 new or replacement administrative systems.
- Since the financial systems form the foundation needed for many of the enterprise-wide systems used at Stanford, they were first in the place for replacement.
- Stanford wanted to re-engineer its business processes in conjunction with the delivery of new systems whenever possible to help maximize potential savings.
- Stanford had decided to look to the marketplace for new systems solutions. The ongoing and exit costs of proprietary software solutions were proving to be quite high. Our goal was and is to use vendor packages, industry standards and expertise.
- A new Information Technology Systems and Services organization was being formed to be led by a vice-presidential level Chief Information Officer.

- Our new systems would be open, standards-based, state of the art, distributed client/server (insert your favorite buzzword here)....

Category Two: What We Knew We Didn't Know

We knew we wanted to be client/server and distributed, but as an organization, we possessed little knowledge and experience in these newer technologies. We knew we needed to quickly gain and/or buy (contract for) expertise in:

- distributed computing
- relational data bases
- application development tools
- object technology
- new languages, including visual programming languages
- frameworks
- middle ware
- analysis and design methodologies
- project management processes, standards, and techniques

Since we knew we wanted to implement vendor provided and supported products whenever possible, including application packages, we knew we needed to find out more about vendors of client/server packages.

The category of what we know we don't know has grown significantly as we began the process of finding answers to our questions. That's how we know that items are moving from Category 4 (what we don't know we don't know) to Category 2(what we know we don't know). For example, we didn't know that we needed to understand maturity of client/server vendor solutions until we began to explore the package system marketplace.

Issues that we now understand need to be addressed and/or questions that need to be answered include:

- What is our target technical architecture? What is our strategy for achieving it? Current marketplace solutions often do not conform to the target environment.
- What criteria will we use to evaluate vendor packages? What is the decision making process?
- What industry standards do we want to adopt? There are many to choose from. Microsoft sets the de facto standards, just as IBM did for mainframes.
- What 'flavor' of client/server architecture is desirable: two-tier, three-tier, multi-tier?
- Just how open do we want/need our architecture to be?

Plug and play sounds great. Are we ready for the multi-vendor, multi-site license, version control headaches this approach brings, or can we make progress more quickly by purchasing application suites that provide proprietary solutions.

- What exactly is meant by integration in a client/server world anyway?
- What relational database vendor do we want to use? Can we afford to support more than one?
- How is security provided in a client/server world
- How object-oriented do we want to be?
- How do we measure system success? Is the goal efficiency and cost reduction? Or is the goal effectiveness and better service and support?
- How is a project-based organization different from a traditional, hierarchical organization?

In what is probably a common approach when there is so much work to be done, so many questions to be answered, and so many decisions to be made, we started everything at once.

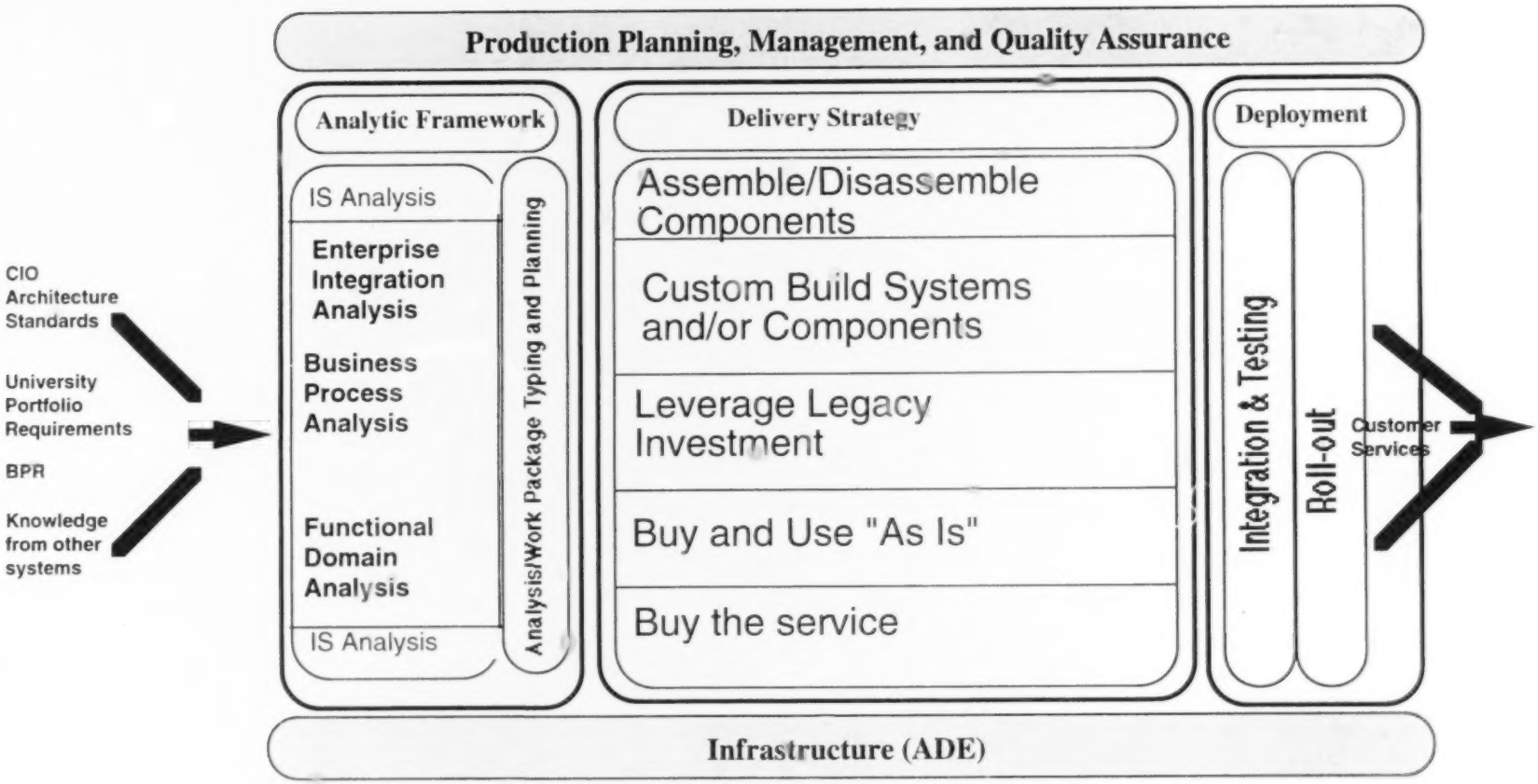
Good News and Bad News

The good news about starting many efforts at once is that knowledge is quickly added to the "what we know we don't know" category. The bad news is that forward progress is quickly impeded by the large number of unknowns that must be dealt with. This can quickly lead to demoralization and "analysis paralysis" when it appears that so many decisions in so many areas need to be made at a time when there are so many unknowns in our industry.

In order to provide focus on the new systems work needing to be done, a separate organization was formed, Information Systems. Staff in the newly formed IS are not responsible for support of existing systems. Working with clients, they formed project teams to perform the detailed requirements gathering process needed to begin package evaluation and selection. As part of the AIS plan, it had been decided to look to the marketplace for system solutions and to limit the amount of custom development; however, we needed a framework for when to buy and when to build.

Although work could progress on functional requirements in the absence a defined technical architecture or a uniform process for vendor and package evaluation, we quickly determined that a defined systems delivery process for the new I.S. organization would streamline our work. In the autumn of 1994, an I.S. focus team was formed to examine concepts of component re-use and assembly, and to recommend an approach for delivery of new systems. The team identified several inhibitors that could lead to less functional, less integrated systems than our current legacy systems. The team made the following recommendations:

"The Software Shop" an I.S. Business Model



(figure 1)

BEST COPY AVAILABLE

- A new process for system delivery that would include:
  - portfolio and functional domain analysis
  - enterprise data and process views
  - alignment of the delivery solution with the value of the business process
  - componentizing of applications

- A new method for identifying reusable components:
  - functional and process domain analysis to meet the needs of the central administrative offices (functional view) and the schools and departments (processes such as 'establishing a new course' that go across many functions)
  - intersections identify potential areas for reusable components
  - frequently used functions, for example: cut a check, within a functional domain are also candidates for re-use

- A new process for determining value
  - priority processes support identity process such as teaching and research
    - drivers are increased market share
    - often differentiate a "business" from its competitors
    - customized system solutions are often required
  - background processes are business processes, such as purchasing, that are needed by any business
    - drivers are low cost and efficiency
    - package solutions usually meet all requirements
  - mandatory processes, such as those required by environmental health and safety, are those required by outside agencies
    - package solutions will meet common requirements, like compliance with tax laws via a payroll system

The team created a process model for I.S. that we called the Software Shop. (figure 1). Like any process, the Software Shop has inputs and outputs. The inputs are: architecture, standards, business process redesign, and knowledge from other systems. The output is a new application. The process is supported by an application delivery environment (ADE) infrastructure, and is managed via planning, quality assurance procedures and organizational direction and oversight.

The Software Shop process has three components: analytic framework, delivery strategy, and deployment. The analytic framework requires three kinds of analysis. Enterprise integration analysis determines how the proposed system interfaces with others. The data and process models for the new system are integrated into existing enterprise data and process models and both are modified as needed. Areas of potential overlap or missing functionality are noted. Business process analysis maps a business process from beginning to end and notes the need for information or process logic that may be provided by other systems. Functional domain analysis identifies common procedures within a functional domain (such as financial systems) that can be re-used by many applications.

The delivery strategy is based upon whether or not the system is a priority system or a background system. Most administrative systems support background and mandatory processes. There are five delivery strategies. These strategies are not mutually exclusive, but represent mix and match approaches that will probably be used in varying proportions for the delivery of all new systems. The first approach is: buy the service. This suggests that no systems are installed at Stanford to support this business process. Both the business process (or function) and the systems that support that function are out-

sourced. An example of this might be a lab store. The store would be run by an independent business and that business would be responsible for keeping it stocked appropriately, and for providing any computer systems it needed to do so.

The second strategy is to buy a package and use it 'as is'. This strategy implies that the business practices may need to change to fit the package. A third strategy is to leverage our investment in legacy systems. Stanford has created excellent authority, routing and work flow applications. Potentially these systems can be 'componentized' or 'wrapped' so that newer systems can make use of their functionality. The remaining two strategies would be used primarily for priority systems. These strategies call for building systems and components and assembling them to create new applications.

The deployment component of the Software Shop model begins with the integration of system components, and testing of the resulting application. This new system is then rolled out for general use and turned over to the application support organization.

The I.S. Software Shop recommendations were completed in early 1995, and the I.S. organization was subsequently re-organized around the concepts in the model. The I.S. organization was structured into six units: Application Project Integration (API) was formed for the analytic framework process; Application Assembly and Integration (AAI) was formed to deliver and deploy applications; the Projects and Planning Office was formed to introduce and support standard project management methods and quality assurance practices; the Application Support Center (ASC) was formed to provide and support the application delivery environment; and Application Resources (AR) was formed to support the acquisition of staff for the projects. The sixth unit, Data Administration, was already in existence.

Parallel Efforts

While the I.S. organization was being defined and formed, many projects had already begun. Each team was defining its own processes and approaches, and making its own assumptions regarding technology, package usage, vendor selections, use of object technology, etc. Outside the I.S. organization, infrastructure projects were being prioritized, and a project management and system development methodology was being chosen.

As might be anticipated, the result of these uncoordinated and sometimes conflicting activities led to organizational confusion. In addition, the sheer magnitude of work to be done often resulted in communication breakdown. There was a general lack of understanding of the new I.S. organizational structure, both within I.S., and among our clients and other parts of our parent organization, ITSS. The lines of authority between and among line managers and project managers were not clear. Project managers were accustomed to having line manager responsibilities. Line managers found themselves largely in support roles, with little or no staff.

At the same time, the University senior management team (RASOG, restructuring and administrative systems oversight group) charged with overseeing both business process redesign initiatives and the new system initiatives began to realize that it needed to define a clearer decision making process, and to identify when it needed to be involved in review of the initiatives. As a result of the selection of the Navigator methodology from Ernst and Young which defines the roles and responsibilities of sponsors, executive sponsors, project managers, steering committees, and executive steering committees,

RASOG began to realize that more and consistent structure and support was needed across all systems initiatives.

Where We Are Today

Several resignations among the management of the I.S. organization created the opportunity to re-examine our structure. The basic organizational unit is still the project. There is a high level of acceptance of project structures recommended by Ernst and Young's Navigator methodology which calls for involved and committed project sponsorship, full time project managers and project team members, and project steering committees. The I.S. organization has been reconfigured and now has only 3 line units: data administration, project support and improvement, and architecture and infrastructure services. In order to keep infrastructure projects aligned with application projects, we are forming steering committees for infrastructure projects that include project managers of the application system initiatives. We've come to realize that the sheer magnitude of the work to be done is far too great for existing staff to accomplish in the time required. We are now in the process of 'pre-qualifying' vendors as technical partners.

A change support team is being formed which will provide support to the multiple change initiatives, especially supporting the entire University community in the areas of training and job redesign and many new systems and procedures are introduced across campus. reporting to executive steering committee. The change support team will also be responsible for high-level coordination of the initiatives in order to help manage the level and rate of change being introduced during any one period of time. The team will define and implement consistent communication to the campus.

Several related projects are being integrated into a core financials program. This will help to keep these projects aligned and coordinated. An integrated package suite will be chosen to support the core financials, and will help provide, by default, an applications architecture, infrastructure and language that can be built upon as needed. This decision will move more items into category 1: the things we know.

Lessons Learned

1. The senior management of the information technology (in our case, the direct reports to the Chief Information Officer) need to agree on technical direction and approach.

   Differences of opinion in areas such as build vs. buy, whether or not to embrace object technology, and methodologies make it difficult for the project teams to proceed.

2. There needs to be general understanding, acceptance and buy-in of new organizational approaches.

   The project managers in the I.S. organization did not understand the functions and purpose of the line units. This led to resentment, lack of trust, and a disassociation with the organization itself. Projects became self-contained units with little or no management or oversight from I.S.

3. Line managers must have expertise in their areas of responsibility.

   This would seem to be self evident, but when it is overlooked or ignored for whatever reason, the entire organization suffers.

4. Don't use inexperienced contractors in key management roles.

   The position of Manager of Application Assembly and Integration was outsourced, since it was felt that no one at Stanford had experience in component creation and assembly. Having a contractor in a management position created many problems. These were compounded by the fact that the contractor selected for the position was an unseasoned manager.

5. The culture of the organization needs to be used to introduce change.

   Stanford, like many Universities, has a very consensus-based culture. This fact was largely ignored when establishing the new I.S. organizational structure. Without taking the time to get understanding and buy-in, the new approach was never accepted, and in some instances, was actually fought.

6. Line managers must understand their primary role is to support project managers and project teams.

7. Don't turn process into structure

   To be successful, projects will use the analytic framework, delivery and deployment strategies outlined in the Software Shop. The attempt to turn system delivery processes that teams should follow into an organizational structure was not a good idea.

8. First you plan

   Stanford jumped immediately into starting projects, largely because the Strategic plan had a start date of September 1994. We now realize our job would be easier today if we had taken the time to plan to the next level of detail, identified an optimal sequencing of application and infrastructure projects, selected application delivery tools, production data bases and platforms.

   Steps to include in a planning effort include the following:

   - Define a long term technical direction and strategy
   - Identify impacted systems and business processes
   - Define an architectural approach
   - Determine infrastructure, middle ware, and the common business services (modules) needed by enterprise-wide applications
   - Map dependencies
   - Create a tactical plan

9. Change takes time

   Implementing systems and the associated analysis and planning effort takes time. Acceptance of new structures and approaches takes time, consistent messages, and patience.

10. There are no silver bullets

Enterprise-wide client/server systems have much to offer; however, there is some step back in functionality from highly integrated mainframe environment. Processes taken for granted on the mainframe, such as authentication, version control, work flow, routing and email integration are just starting to appear in client/server systems.

Required flexibility and ease of change require closer attention to architecting systems in a standard manner, building (or if possible componentizing packages into) smaller single or few function modules with standard published API's

Be prepared to implement short team solutions that can be replaced; concepts are ahead of the marketplace.

The Nice Surprises

Remember the third category of knowledge: what you don't know you know. During the past year, we've had some pleasant occasions when we realized that we knew more than we thought we did. Mainframe knowledge is transferable. Screens may be called the presentation layer and be GUI, but they are still used for the same purpose. Business logic is still business logic and data is still data. The processes used for gathering requirements still work. Data models are still quite useful. Project Management skills are still very important. Every once in awhile the old adage is true: the more things change, the more they stay the same.

Multimedia and Asynchronous Learning: Changing the Role of Academic Computing

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Abstract

The traditional paradigms for teaching and learning follow the Socratic model which is not only time and place dependent but predominantly uses linear teaching tools such as the lecture and textbook. The changing nature of the workforce and the increasing demand for higher education to reach students off campus requires us to look at new paradigms for teaching and learning. After decades of promises based on overhead projectors, classroom video, teaching machines, and other instructional technologies, the ability to improve instruction by integrating digital technologies across the curriculum has become a reality. By incorporating digital text, audio, graphics, animation, and full motion video into the lecture, laboratory, self-study, interpersonal and intergroup communication activities that are fundamental to teaching and learning, the quality of both increases. To effect these changes the nature of Academic Computing Units will need to transform itself if it is to support these emerging technologies and cultural changes.

Introduction

After decades of promises based on overhead projectors, classroom video, teaching machines, and other instructional technologies, the ability to improve instruction by integrating digital technologies across the curriculum has now become a reality. By incorporating digital text, audio, graphics, animation, and full motion video, into the lecture, laboratory, self-study, interpersonal, and intergroup communication activities that are fundamental to teaching and learning, the quality of both increases.

A paradigm shift is taking place in instruction, from a mode of faculty-student interaction taking place in specified locations (campus classrooms) at specified times (class schedules or office hours) to one in which students have access to most of the information content in a variety of forms at their convenience (when the choose, and where they choose from a variety of locations, including their living quarters). This shift is possible because several technologies have matured that provide the basis for major changes in the delivery of instruction. Education in the future must support both synchronous and asynchronous interaction between the learner and the sources of knowledge and information. Real-time, simultaneous two-way video presentations, multimedia presentations, and "education on demand" can be delivered to students on the campus, in their homes or their work places. Connectivity to the Internet and World Wide Web allows students and faculty to access educational resources anywhere in the world to supplement these aforementioned services.

Escalating costs, declining financial support, increasing demand, and diverse demographics have placed significant pressures on higher education to become more productive. Careful analysis shows that the productivity improvements required cannot be achieved by increasing the workload of the faculty; in fact, any significant movement in this direction will only decrease the quality of instruction. There is simply no room left in the workday of a faculty member to teach more students. Rather, the focus for productivity improvement must be on learning.

It is this realization that is leading to a paradigm shift where students gain access to information resources, faculty lectures and demonstrations, conferencing and tutorials over networks from digital information organized in servers by the faculty. The productivity gains occur in both retention, more efficient use of the student's time, easy access to group studying over networks, better feedback to faculty, and organized self-assessment and self-pacing. Faculty and traditional classrooms are not replaced, but another dimension is added that greatly improves the efficiency of learning. As this new process of using technology to improve learning develops, more students will be able to take advantage of this type of instruction.

Virginia Commonwealth University (VCU) has been exploring several cost-effective teaching models and technology solutions which are designed to improve learning productivity, reduce labor intensity, provide new ways of delivering education and better services to students while improving the quality of instruction. If effective, these concepts could be integrated with and, expanded to, other programs and institutions.

Strategic Plans and Goals

Over the past two years VCU has embarked on a strategic planning effort to define the future role of information technology in support of the university's academic and administrative programs. The VCU Strategic Plan states that technology will be used to deliver traditional education to the University, the community, the Commonwealth, the nation and to the world.

The visions that emerged recognize that technology can benefit learning when it:

- allows a student to take a more active role
- allows a teacher to express the content of a course in more than one format
- effects students by using techniques that reach various learning styles
- broadens the array of resources brought to a cla sroom and the student's workstation
- increases the opportunities for interactions between teachers and students and among students
- increases the productivity of those who support the learning environment

Instructional computing in the next decade will be symbolized by communications between machines, office and office, classroom and library, teacher and student, the campus and the world (network connectivity) not by isolated desktop machines. The next revolution will be less about the technology of computation than about access to information and ways of sharing information. Consequently, this revolution will involve most members of the university communities not only those who have been traditional beneficiaries of technology.

In the new environment, every instructor or student working alone at their office desk or working with others in any campus classroom will access not only the powerful tools of the desktop computer, but also the networked applications and information resources of the University and the world beyond.

The plans envision high-bandwidth network connection to faculty offices and classrooms, network port distributed throughout the campus, high-bandwidth/telephone access from off-campus sites or residences, classrooms equipped with systems for displaying prepared lecture material and sharing information resources, on-line processing of grades and other student records, and desktop search and retrieval of a wide variety of library materials, including multimedia, international journals, databases, reference works, and scholarly discussion groups. Also they call for a new methodology for faculty to conduct and publish research, create and deliver lectures, and interact with students.

The speed and scope of change in instructional methods promised by the new technology is unprecedented in educational history and will require unequivocal institutional support not only to create the infrastructure to make this possible but also to meet the need for faculty motivation and training.

This plan calls for institutional policies to encourage individual faculty to make the required investment of time and effort, provide incentives for faculty development such as release time or direct pay to conduct and/or attend training, consider professional development in this area for retention, promotion and tenure purposes, and support faculty with well-defined projects for experimenting with new technologies and innovative ways of employing them in the teaching, learning, and research processes.

Achieving these goals will move these institutions toward becoming fully integrated "virtual universities" utilizing asynchronous learning networks in which students, faculty and staff are linked by electronic mail, two-way interactive video, on-line processing, electronic databases, library services, multimedia-on-demand, and other information technologies without regard to physical locations.

The potential benefits of moving in this direction include:

- enhanced quality of instruction
- access to information and library resources
- high levels of support services to existing students
- increased access to academic programs by non-traditional students
- improved effectiveness in uses of limited human, program and financial resources
- net revenue streams to offset infrastructure and operating costs
- incentives to faculty to develop new educational materials

Applications envisioned

This vision would support and enhance traditional instruction, non-traditional instruction and administrative processing. Typical applications could include:

Delivery of education to students in classrooms at multiple sites in the continental United States and internationally, e.g.:

- capturing unique faculty experts and special lecturers on video to augment lectures/courses
- downloading information from multiple sources into a multimedia presentation in the classroom
- teaching low enrollment courses at multiple campuses using two-way video and electronic teleconferencing and collaboration software
- evaluating student teachers remotely in the classroom and communicating via electronic mail
- teaching remediation courses at senior universities remotely from community colleges
- conducting library/text searches on-line world-wide
- requesting assistance via electronic mail with timely responses from faculty
- interaction between students or students and faculty utilizing bulletin board or conferencing software

Delivery of education to non-traditional, off-campus students in their workplaces or homes, e.g.:

- specialized training and retraining programs for industry
- professional licensing/certification courses
- adult education/enrichment programs
- continuing education or degree credit programs
- advanced placement courses to high school students

Implementation Plans

Electronic Campus and Digital Library
VCU is rapidly becoming an "electronic campus," providing access to all major resources through a ubiquitous network. This fiberoptic network connects all buildings and residence halls on both the academic and medical campuses, and will link to a "Digital

Library" to support the concept of a "virtual university" and asynchronous learning networks, as shown in Figure 1. The "Digital Library", Figure 2, will provide faculty and

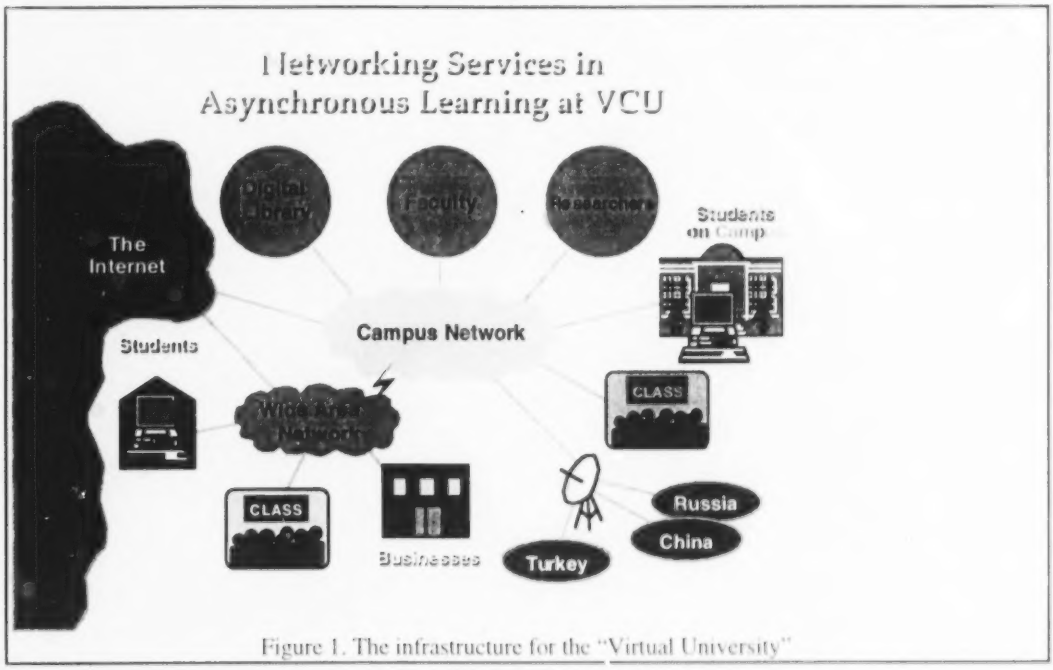

Figure 1. The infrastructure for the "Virtual University"

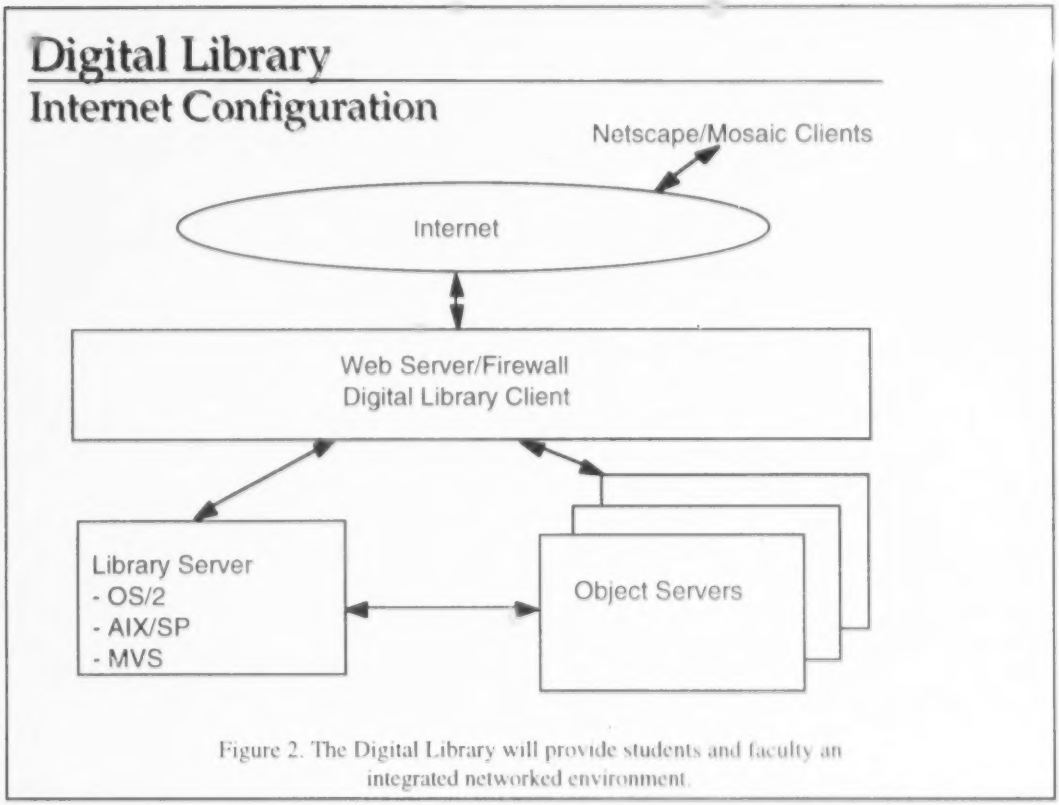

Figure 2. The Digital Library will provide students and faculty an integrated networked environment.

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students with on-and off-campus access to a full range of information technology resources (voice, data, video) in an integrated, networked educational environment. It also will facilitate local and statewide access to full-text articles and publications, electronic library services, databases, multimedia presentations, a central repository of CD-ROM materials, interactive television, and a wide variety of other material including slides, graphics, and video. It will also serve as an important node in a client-server topology supporting campus-wide services and functions in a multi-level server architecture, Figure 3.

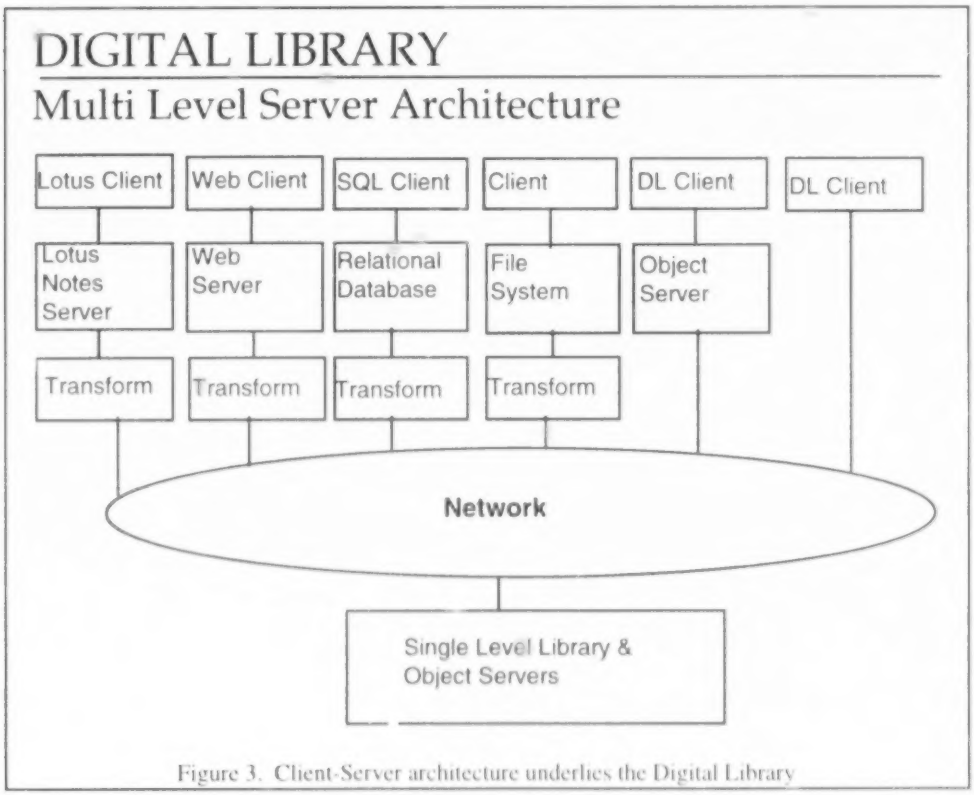

Figure 3. Client-Server architecture underlies the Digital Library

Authoring Workstation

VCU is equipped with both IBM and Apple authoring workstations and software tools, including image editors (PhotoShop), video editors (Premiere, D-Vision) and authoring packages (Persuasion, PowerPoint, ToolBook, Authorware, Hypercard, Action and Director). Other resources available to faculty include scanners and digitizing stations to convert source material from work process, VHS tape, laserdisc, CD-ROM, illustrations and artwork, full video production facilities including a video taping studio, hand-help video cameras for off-site work, digital, video and sound editing studios, and in-house support for creating VHS tapes and CD-ROMs.

Electronic Classrooms

VCU is committed to developing "electronic classrooms" equipped with high-resolution projectors, quality audio, microcomputers with high-speed network access, and presentation software. Faculty will be able to bring their own presentation control software to the classroom, connect to a local or remote server, and access a wide variety of digitized

materials to enhance a classroom lecture under their individual control. This concept is illustrated in Figure 4. VCU now has several classrooms equipped with large-screen video projection systems, Macintosh and IBM-compatible computers or interfaces, and network connections. Although delivery of full-motion video is limited at present, several programs (e.g., the School of Pharmacy and the Department of Physics) are developing content which requires the delivery of full motion streamed video.

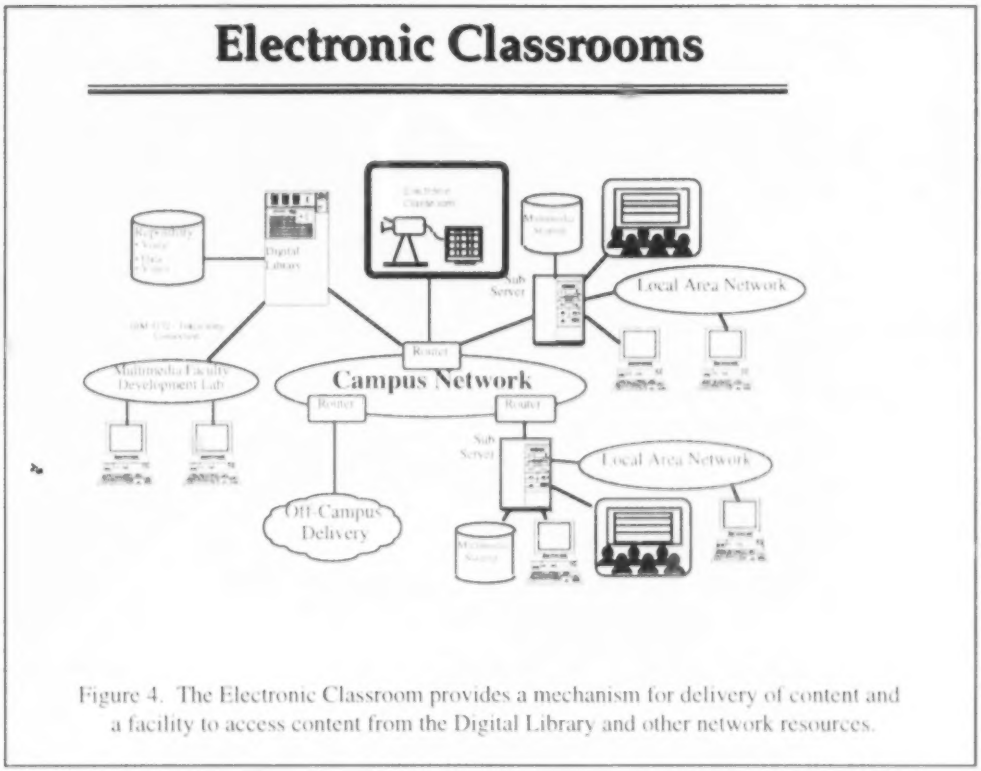

Figure 4. The Electronic Classroom provides a mechanism for delivery of content and a facility to access content from the Digital Library and other network resources.

Virtual Classrooms

VCU is developing the capacity to "digitize" lectures which can be edited, indexed and stored along with course materials. Both the lectures and materials can be retrieved later to supplement existing classroom instruction, either as stand alone video, or more likely integrated with interactive multimedia presentations. A system for interactively is being developed to encourage conferencing and interaction between the faculty and students participating in this "Virtual University". Initially, this will be accomplished through electronic mail, bulletin boards and newsgroups, or software such as *Lotus Notes*. Today with these tools students and faculty can communicate electronically whenever they like. Assignments can be given and received electronically. Faculty can hold "virtual" office hours, freeing them from rigid schedules, and enabling students to obtain information with little loss of time. Although the method for student/faculty interaction will change, these technologies should allow the quality of interaction be maintained, or, in the case of the large lecture, improved over current levels.

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The Role of Academic Computing

Prior to 1980 the role of an academic computer unit was typically to operate a mainframe and provide software consulting support for the users of these large, timesharing machines. When the personal computer revolution began, academic computing centers invariably took the lead in offering all levels of support: consulting, training, even repair. A decade later, personal computers became ubiquitous and support moved from a centralized model (where academic computing units supported the PCs), to a decentralized one (where departments now provide for basic PC support). The primary reason for this is that personal computers are no longer new and the knowledge to support them can be readily found.

The example of personal computing represents a fairly well-established process of migration of support. In other words, when the technology is no longer new or rare or exotic, the role of the academic computing center transitions to the support of emerging technologies (e.g., World Wide Web and client/server technologies) while the support structure for mainstream technologies (e.g. PC support) migrate to the academic and administrative units. For this reason academic computing units today have made a major commitment to supporting and disseminating information about networks, the Internet, the World Wide Web, and multimedia education.

At VCU the changing role of academic computing support has manifested itself in many ways:

Multimedia Development

A new faculty support unit has been created to provide the leadership for the creation of a student-centered and asynchronous learning environment at VCU. This new unit provides not only the consulting expertise to assist faculty in the development of their own skills, but has expertise in instructional design, applications development, network implementation, media digitization and editing, and systems programming to create a successful educational module. The role of this unit is to facilitate development of multimedia applications in the distance, distributed and asynchronous educational field. At VCU the Multimedia Development Center works to change the way that faculty look at the traditional teaching and learning paradigm; and to use asynchronous products to promote teaching and learning outside of the traditional classroom.

Faculty Support

The role that Academic Computing units play in faculty support must also change. In the past the training has been primarily given in brief training sessions of one to three hours, and has been a scatter-gun approach which has not reached the mainstream faculty. VCU is now developing a major effort to provide 40 hours of intense hands-on training for each faculty member in all the newest technologies of multimedia and asynchronous learning. During these workshops the faculty will begin to create content that can be accessed over the University's data network, the Internet and World Wide Web. The faculty member will come away from this training ready to take an active role in planning and implementing changes in the way he/she teaches.

The Cyber-Consultant

The traditional role of consultants in Academic Computing units has been to provide one-on-one, face-to-face consulting. As the faculty home base moves away from the mortar and bricks of a campus, and as students become less willing to be campus and classroom bound, the consultant will need to learn how to provide consulting information without ever seeing the person face-to-face. In fact, the consultant will use the same tools that are being developed for teaching and learning at the "Virtual University". They will need to

practice what they preach, and by using these tools become more accessible to faculty and student alike.

Access to the Ubiquitous Network

Providing full Internet access is a major support issue which has already emerged. VCU has decided to outsource this function to a private Internet provider. The infrastructure to create this function for 2,000 faculty, 5,000 staff and 20,000 students is prohibitively expensive in today's changing market. In fact, it is likely that the entire infrastructure will need to be changed in two years. Today's 28.8 kb modem over analog dial up may be today's technology choice, but ISDN is likely to replace it in the next several years as the need for higher and higher bandwidth to the desktop are dictated by the emerging technologies of the World Wide Web and the Digital Library (e.g., full motion video and high resolution imaging).

The role of academic computing support has changed because the level of access to information has become so pervasive. In a brief twenty years, Academic Computing units have moved from supporting a few mainframe users with terminals on campus to supporting students and educators world wide who demand better service from their office, home, or residence hall, and even from foreign lands.

Conclusion

Technological advances to deliver education-on-demand are progressing rapidly. VCU plans to take this technology and apply it to education in order to overcome the economic, cultural, and physical barriers to learning facing the United States and the world. This includes continuous retraining of the workforce.

The current economic restructuring plans causing "downsizing" combined with unprecedented growth in demand for higher education will require universities to mirror business and industry by delivering "just-in-time" rather that "just-in-case" education, and to pursue cooperative efforts with the private sector to achieve this vision.

Virginia Commonwealth University will not achieve these goals all at once. We intend to proceed deliberately, with a careful eye on changes in technology that may change the goals, and on vicissitudes in the economy that enable them to implement the new pedagogical paradigm. Still, universities must begin proceeding now toward an asynchronous learning network environment and a new faculty support structure if they are to deliver the sort of education the students will need and demand as we move into the next century.